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The Implications and Development of Telecommunications

Center for Economic Development

Planning For Industrial Development

The Implications and Development of Telecommunications

Part I: Research Paper
Part II: Analysis Paper

prepared by:
Christine M. Lemay

prepared for:
Professor John Mullin
Regional Planning 691M

May 14, 1997

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Planning For Industrial Development

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Part I: Research Paper

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Part I: The Implications of Telecommunications

1.0 Background: The Telecommunications Act of 1996

The Federal Communications Commission (FCC) mandates that personal wireless companies develop their systems so that adequate service is provided to the public. Section 704 of the Telecommunications Act of 1996 governs federal, state and local government oversight of siting of "personal wireless service" facilities (Wireless Telecommunications Bureau, 1996). The FCC published a Fact Sheet in April of 1996 which summarizes the key provisions of section 704. The summary is as follows:

- Local zoning authority over the placement, construction, and modification of personal wireless service facilities is maintained by the Act. However, zoning may not:

  1. discriminate between different personal wireless service providers (i.e. cellular, SMR, and PCS). Communities retain the flexibility to consider the visual, aesthetic, or safety considerations when approving competing applications (Conference Report, Section 704, 1996).

  2. altogether ban the construction, modification or placement of these kinds of facilities in a particular area.

  3. use health and environmental effects of radio frequency (RF) emissions as a reason for siting denial to the extent that such facilities comply with the FCC's regulations concerning such emissions (see health and safety concerns, section 2.1.2). In all cases of refusal, written documentation based on sound evidence must be provided.

- As with other zoning applications, communities must act in a timely fashion to requests for siting of wireless facilities. "If a request for placement of a personal wireless facility involves a zoning variance or a public hearing or comment process, the time period for rendering a decision will be the usual period under such circumstances" (Conference Report, Section 704, 1996).

- Complete moratoria on wireless facilities siting applications are not congruent with the intent of Section 704, which prohibits policies that "have the effect of banning personal wireless services or facilities...". The FCC and the industry prefer that decisions be made on a case-by-case basis, yet some communities have adopted a moratoria despite this (see Section 2.2.2).

- Federal agencies owning land are mandated to make property, rights-of-way, and easements under their jurisdiction available for the siting of wireless facilities. A presumption is established that requests for tower and facility siting be summarily granted if not in conflict with the agency's mission or its current and future planned use of the property. Whereas federal agencies are mandated to make federally owned land available for the siting of wireless facilities, state agencies are only "encouraged" to do so. Both are exempt from local zoning regulations.

2.0 Benefits and Concerns raised by Telecommunications

There are many benefits associated with wireless telecommunication facilities. These include:

Law Enforcement	Mobile transmission of fingerprints, mug shots, warrants, and other images to and from law enforcement field personnel.
	Mobile transmission of maps, floor layouts, and architectural drawings for crime-in-progress operations.
	Tactical use of live mobile video for hostage, arrest, and surveillance operations.
	High-resolution graphics and electronic transfer of maps and other graphic information to police vehicles
	Vehicle and personnel tracking systems.
	Wireless "dog tag" locator services to help assure personnel security.
	On-board information and security systems for mass transit vehicles.
Energy Conservation and Management	Advanced distribution automation, such as remote monitoring, coordination, and operation of distribution and transmission components from centralized locations, for load management, advanced metering, and system-control functions.
	Demand-side management systems: for example, managing the consumption of electric power and natural gas.
	Real-time monitoring, alerting, and control in situations involving handling of hazardous materials.
	Transmissions to monitor and record pipeline flow and pip line pressure indicators.
Health Care, Fire, and Emergency Systems	Remote monitoring of patients' vital signs in health-care facilities to allow immediate response in the event of a patient medical crisis.
	Mobile transmission of maps, floor layouts, and architectural drawings to assist fire fighters and other response personnel in the rescue of individuals in emergencies.
	Transmission of visual signals and physician instructions in support of rescue operations.

Fire/Emergency Medical Systems continued	High-speed transmission of high-resolution medical imagery and data from paramedics to hospitals.
	Automated inventory control.
Pollution Control	High-resolution graphics and electronic transfer of maps and other graphics information to mobile users.
	Management and remediation operations following spills or other crises.
	Real-time monitoring, alerting, and control in situations involving handling of hazardous materials.
	Visual inspection of pipes and cables exposed during excavation projects.
Industrial Productivity	Automatic transmission of messages advising of impending shortages of parts in a manufacturing environment.
	Vehicle and personnel tracking systems.
	Locator service based on wireless transmitters to address personnel security.
	Remote safety and security inspection of inaccessible locations.
	Automation of process and quality control functions.
	Transmission of scheduling and cost updates, job site inspection results, and performance assessments relating to construction projects.
	Wireless "face-to-face" conferences between in-house production and sales personnel.
Intelligent Vehicle Highway Management Systems (IVHS)	Traffic management systems that adjust to actual traffic conditions rather than rely on historical patterns.
	Systems that can electronically weigh and inspect commercial vehicles in motion, issue and monitor permits, or track a container throughout a multi-modal shipment.
	Systems that permit electronic collection of tolls and transit fares.
	Devices that alert authorities to the need for emergency vehicles at the site of a collision or other roadside situation.

Source: National Academy of Engineering, 1995

Developing telecommunications infrastructure can make life easier, safer, more productive and convenient. Despite the added benefits of wireless facilities, there are a number of concerns.

Table 2.1 Community and Industry Concerns

Community	Industry
Devaluation of property	Providing a seamless network for better quality of service
Health and Safety	Prolonged and uncertain application process
Visual impacts / Aesthetics	

2.1 Community Concerns

The three hottest issues raised by communities concerning wireless facilities are the devaluation of property, the health and safety of citizens, and the visual/aesthetic impacts of such facilities on the character of the community. Typical local government responses to these issues are addressed in Section 3.0 of this report.

2.1.1 Devaluation of property

One of the commonly asked questions is, "Will having a radio link located nearby devalue my property?" AT&T Wireless Services states that "there is no negative impact on real estate values from radio link installations." This finding is based on numerous studies conducted by real estate experts, appraisers, and by community planners (1996). Despite this assurance, decreasing property value is one of the three most common arguments against approving applications for the siting of wireless communications towers (the other two are aesthetic degradation and health risks) (Merainer, 1996).

2.1.2 Health and safety concerns

The Telecommunications Act of 1996 states that "no state or local government...may regulate...wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commissions's regulations concerning such emissions."

It is fundamental that the wireless industry provide information to the community regarding Radio Frequency (RF) emissions in order to alleviate the public's health concerns.

The following tables represent some comparative findings from a study done by Peter A. Valberg, Ph.D., Gradient Corporation And Harvard School of Public Health (1996).

Table 2.1.2.1 The Comparative Power Levels of Several Energy Sources

Source	Power Level
Single light bulb	100 W
Single cellular telephone base-station antenna	100W
Kitchen toaster	1,000 W
Array of base-station antennas	1,200 W
Typical radio station transmitter	50,000 W
Typical UHF TV transmitter	1,000,000 W

Table 2.1.2.2 Electromagnetic Energy per Unit Area

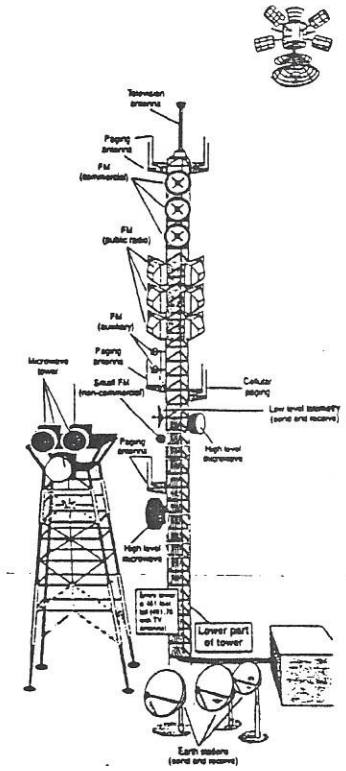
Electromagnetic Energy	Energy per unit area
Sunlight at the earth's surface	135 mW/cm^2
Heat radiation from a human body	2 mW/cm^2
Health standards for 850 MHZ: Occupational Public	2.7 mW/cm^2 0.550 mW/cm^2
3 feet from a 100 - watt light bulb	0.80 mW/cm^2
Typical maximum levels from cellular-telephone base antennas	***0.01 mW/cm^2***

The Institute of Electrical and Electronic Engineers (IEEE), which sets one of the most conservative exposure limits, has publicly stated that "the typical wireless base station emits no more radio frequency energy than is normally found in ambient levels in any modern community" and concludes that "base stations pose no risk to the public" (New Jersey Wireless Carriers Coalition, 1996).

Safety issues aside from those related to health range from lighting, fencing, warning signs, to the possibility of tower collapse. The provider is responsible for carrying liability insurance and will agree as part of the lease (of land) to carry the responsibility for injuries or damages resulting from its operation (King, 1996). Zoning regulations highlighted in Section 3.0 address such concerns.

2.1.3 Visual impacts and aesthetics

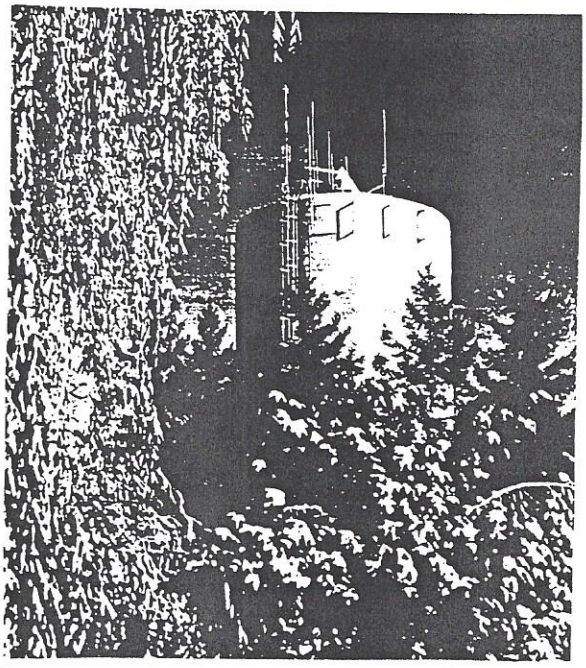
The FCC mandates that wireless providers expand their facilities in order to provide the highest quality of service possible. The Commission is allocating spectrum to personal wireless service providers on an ongoing basis, with the greatest demand for new site construction concentrated in cellular and broadband PCS (Personal Communication Services). Both use low powered transmitters, but at different band widths. Both the increase in the number of users and competition between traditional cellular providers and PCS providers will result in the proliferation of wireless facilities. There are a variety of techniques which can be used by communities in order to keep the visual impact of wireless facilities at a minimum.

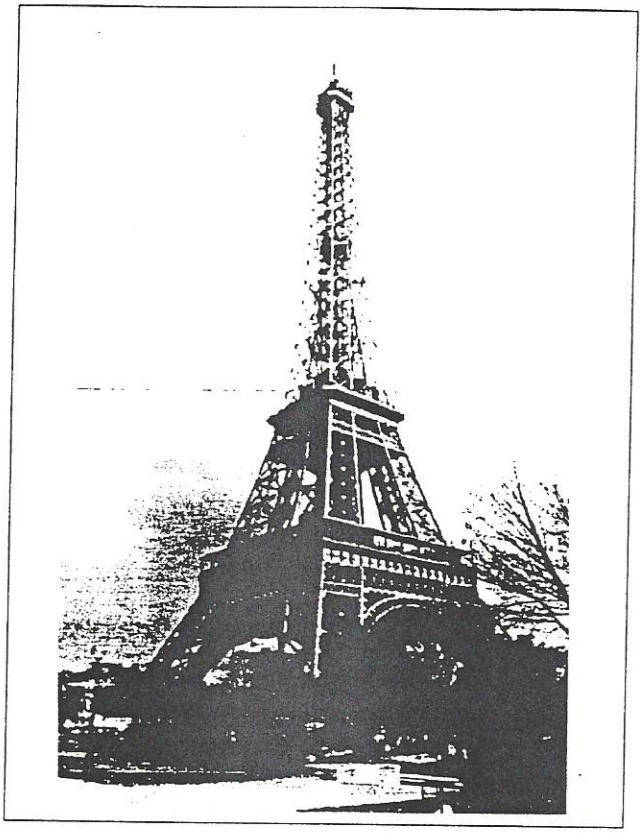


An example of co-location, showing several different services that can be accommodated at different heights on one tower.

Figure 1 (left): Collocation reduces the number of towers constructed, but are highly visible. (*Source: Planning, December 1996*)

Figure 2: Antennas can be placed on existing structures such as water or fire towers. *(Source: AT&T Wireless Services)*





Some techniques include:

- co-location of antennas whenever technological requirements allow (Figure 1);
- siting antennas on existing structures such as water towers, fire towers, tall buildings, etc. (Figure 2);
- camoflauging antennas through architectural compatibility and/or surface treatment; and
- Disguising towers by mimicking more natural or culturally accepted shapes, such as trees or church steeples (Figure 4).

Zoning regulations can specify the tower type, appearance, and mandate co-location only to the extent that it does not interfere with the service provider's technological design requirements (King, 1996). The provider must submit proof that the requirements interfere and provide an alternative scheme with the least impact on the community (through the special permit process).

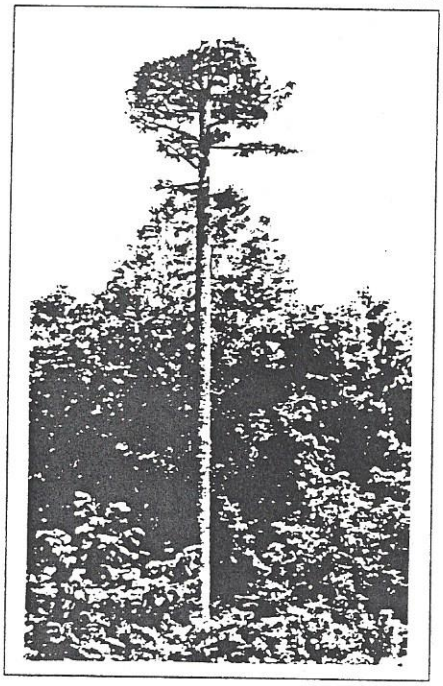


Figure 3 (top): The Eiffel Tower, Paris, was originally built for radio/telegraph transmissions. It now operates as a telecommunications tower. *(Source: Planning, December 1996)*

Figure 4 (bottom): Incognito Antennas: Antenna support structure disguised as a white pine tree. *(Source: NJPJ, Spring 1996)*

Town members will wish to retain the semi-rural nature of the town and should therefore be aware of the many effects of expanding telecommunications on rural areas (Table 2.1.3.1).

Table 2.1.3.1: Effects of Enhanced Telecommunications on Rural Development

Rural Development Obstacles	Benefits from Telecommunications	Drawbacks of Telecommunications
Geographic isolation	Reduces time for information transfer	Lack of concentration of users makes advanced telecom infrastructure an investment risk
	May reduce need for travel	
Declining job opportunities	May decentralize back-office jobs to rural areas	Jobs that do decentralize tend to be low wage
	Opens urban markets to rural business	Opens rural markets to urban business
	Increases business efficiency	Allows firms to bypass rural areas in developing counties
Lack of human capital	Provides access to education and training at lower costs	May not reach those most in need
		May widen gap between information - rich and- poor
		Quality of remote learning may be less
Lack of services	Provides access to education and training	May be expensive to provide
	Provides access to medical services outside of the area	Must overcome lack of familiarity and hesitancy to adopt
Lack of urban amenities	Provides access to electronic media amenities	Does not address lack of non-electronic amenities

(Source: Read and Youtie, 1996)

2.2 Industry concerns

The wireless industry's goal is to provide a seamless network for better quality of service. In fact, they are required to do so by FCC mandate. By FCC standards, service providers agree "to provide cellular service that will work effectively in any spot in the region..."(The Boston Globe, 1997). This includes both rural and urban areas.

The industry faces many challenges when propositioning a community, such as:

- NIMBY attitudes
- moratoriums and local zoning regulations
- a prolonged and uncertain application process

2.2.1 NIMBY attitudes

The issue of wireless facility siting often raises the "Not in my backyard" reaction. The residents of Franklin County, Texas displayed such a reaction to the siting of a multi-carrier telecommunications tower. They argued it would cause devaluation of property values and, in general, "...impair their quality of life" (Planning, 1996). Communities can steer the facilities into areas that are appropriate for such uses. What the community must recognize is that "towers may be permitted in prohibited areas if the provider can satisfy the criteria for an inherently beneficial use and thereby obtain a use variance" (NJPJ, 1996). Nationwide, it is approximated that 28,000 customers sign up for cellular service each day and that 20% of all households own a minimum of one cellular phone (NJPJ, 1996).

Telecommunications is a part of everyday life for many, and the trend is strengthening with the FCC auction of radio band widths to private service providers. Because communities cannot ban or discriminate amongst service providers, it is better to consider telecommunications an essential service and plan for its role and location within the community.

2.2.2 Moratoriums and local zoning regulations

A community may institute a moratorium on wireless facility siting and construction while the long term land use issues are considered and siting ordinances formulated. As of December 1996, there were a few noted cases regarding placing moratoria on the building of telecommunications towers. These included (Planning, 1996):

- City of Medina, Washington vs. Sprint Spectrum: The courts approved a 6 month moratorium which Median held would give it time to plan for cell sites.

- Gwinnett County, Georgia vs. BellSouth Mobile: The court upheld the defendant's position that the County did not present enough evidence to support the denial of a siting permit.

- Franklin County, Texas: This case, mentioned above, represents that many courts will agree that a temporary injunction against the construction of telecommunications towers can be issued based on the premise that towers will impair the quality of life and diminish property values.

Although a wireless communications moratoria works against that intent of section 704 of the Act and is frowned upon by wireless providers because it causes uncertainty and delay, the following are some actions that will make the moratorium as effective as possible (FCC Fact Sheet #2, 1996):

- establish the finite duration of the moratorium.
- communicate the tasks that the local government entity intends to accomplish during the moratorium.
- communicate the ways in which the wireless service providers can facilitate the achievement of the local government's goals of the moratorium (provide information to the community about their needs and their services).

2.2.3 Prolonged and uncertain application process

The wireless industry fought to eliminate local control of infrastructure siting for the following reasons:

- the provider sinks resources into the planning and design of a particular site prior to approval or disapproval of the proposal
- the industry feels that many conditions or exactions placed upon an application for approval are illegal (such as taking a percentage of the provider's gross revenue).
- Siting regulations determine where and how high a tower may be, which may not fit with the technological requirements of the service provider.

Wireless service providers may expedite the zoning authorization process by locating towers on sites that are compatible with the proposed uses, such as industrial zones, utility rights of way, and preexisting structures (FCC Fact Sheet #2, 1996).

Communities can offer incentives for collocation, such as speeding up the zoning application process (FCC Fact Sheet #2, 1996). Communities can also enter into agreements for services, such as locating public safety communications equipment on private towers for little or no cost.

Overall, there need not be needless delays and uncertainty for the wireless service provider if the industry and the community share information and work towards a solution that is least intrusive for the community.

3.0 Local Government Responses to Telecommunication Issues

Many Massachusetts communities have added telecommunication ordinances to their by-laws. Below are approaches taken by communities which respond to the prominent issues of health, safety and visual impacts.

3.1 Health and Safety Issues

3.1.1 Health Issues

A community cannot prohibit the siting of a wireless facility based on health concerns over RF emissions. The RF emissions of a tower are regulated by the FCC and are based on ANSI standards for human exposure. Communities can require that the wireless provider submit proof of compliance to FCC regulations both at the outset of design and construction and at specified intervals while the facility is in use.

3.1.2 Safety Issues

Typical concerns related to safety include tower collapse, injuries sustained upon trespassing and vandalism to the property. In order to address these concerns, zoning ordinances may include sections on the following:

- fencing,
- lighting,
- signage,
- design standards, and
- tower setbacks.

Fencing

Fencing prevents unwarranted access to a wireless facility site, although fencing is generally not required for antennas or other appurtenances mounted on a pre-existing structures. Controlling access to sites prevents accidents and liability suits leveled against the wireless provider.

Communities which require fencing can regulate the following:

- The design of the fencing so that it is compatible with the character of abutting properties.
- The minimum height, extent of fencing and the materials used in fence construction. Most communities disallow barbed or razor wire.

Other approaches to maximizing the security of a wireless facility site include instituting the following:

- a security program that will prevent unauthorized access and vandalism.
- anti-climbing measures to reduce potential for trespass and injury .

Lighting

Telecommunication facilities are not generally required to be lighted (because of visibility issues). For safety reasons however, a community might require the following:

- A manually-operated or motion-detector controlled light above the equipment shed door which shall be kept off except when personnel are actually present at night;
- the minimum tower lighting required under FAA regulation if the tower falls within an airfield zone; and
- where lighting is required, control the intensity and direction of the lighting so as to minimize the amount of light that falls onto nearby properties, particularly residences.

Signage

Signage should be installed which incorporate the following information only:

- the facility's(s) identification,
- a 24 hour emergency telephone number at which the owner or operator can be reached,
- a no-trespassing sign, and
- any others that warn of inherent danger.

Communities may require that signs comply with the signage requirements of their Zoning Bylaw.

Construction Design Standards and Setbacks

In order to minimize the danger of tower collapse, communities can regulate both the height and the setback of communication facilities. Effects, such as the maximum forces expected from winds or ice, should be considered in tower design. These measurements should be applicable to the tower when fully loaded with antennas, transmitters, other equipment, and camouflaging.

Although the actual numbers vary, communities generally require the following:

- that no telecommunication facility be designed and/or sited such that it poses a potential hazard to nearby residences or surrounding properties.

- that the tower be set back a distance no less than its height. "Setbacks for communications towers and monopoles shall be equal to the engineered design fall zone of the structure plus 50 feet to the property line where the structure is located.

- that the setbacks for a communication building shall comply with the setback requirements of the zoning district.

- that guy wire anchors be set back _____ feet from property lines.

Some ordinances allow for variances only if the reduced setback further mitigates adverse visual or environmental impacts than would otherwise be possible.

3.2 Visual Impacts/Aesthetics

When dealing with the visual impact of a wireless facility, communities rely on regulating

- the type of tower (including height)
- the placement(set backs) and screening of the facility, and
- the visual compatibility of design and surface treatment with the surrounding area.

3.2.1 Tower type

There are a variety of tower types. The two most widely used are lattice towers and free standing monopoles. Because a community may require that the installation of communication structures buildings and appurtenances be designed to minimize visual impact, it may regulate the type of tower to be installed. An example is Foxborough's ordinance which precludes all lattice style towers and similar facilities that require three or more legs and/or guy wires for support, allowing only monopoles.

3.2.2 Placement and Screening

Setbacks were discussed in the Section 3.1. Setback regulations serve the dual purpose of preventing accidents upon structural failure and minimizing the visibility of wireless facilities. Furthermore, communities may regulate the extent and manner of facility screening. The following are some typical screening requirements adopted by communities:

- Telecommunication support facilities in areas of high visibility shall, where possible, be sited below the ridge line and designed (i.e., placed underground, depressed, or located behind earth berms) to minimize their profile.

- A landscape plan shall be submitted with project application submittal indicating all existing vegetation, identifying landscaping that is to be retained on the site and any additional vegetation that is needed to satisfactorily screen the facility from adjacent land uses and public view areas.

- Any existing trees or significant vegetation, on the facilities site or along the affected access area that die shall be replaced with native trees and vegetation of a specified size and species...

3.2.3 Visual compatibility

As an added measure of assurance that the facility remains as unobtrusive as possible, communities can require that the facility blends into the surroundings. To such an end, the community may require that:

- details of construction and finish blend with the surroundings to the greatest extent possible (for example, Lunenburg, MA, requires that green and silver paint be used on towers corresponding to those parts of the tower that extend below or above the tree line respectively);
- satellite dishes other than microwave dishes be of mesh construction, except where technical evidence is submitted showing that this is infeasible;
- telecommunication support facilities (i.e., vaults, equipment rooms, utilities, and equipment enclosures) be constructed out of non-reflective materials (visible exterior surfaces only); and
- all building-mounted telecommunications facilities be located and designed to appear an integral part of the structure.

3.2.4 Facility Height (including towers, antennas, support facilities)

Regulations concerning the allowable height of a wireless facility may vary with the zoning district and address both safety and visibility issues. Residential zones are the most controversial and usually have more stringent regulations. Typical regulations are as follows:

- When a monopole is in a residential zone or adjacent to a residential use, it must be set back from the nearest residential lot line a distance at least equal to its total height.
- Telecommunication support facilities shall be no taller than one story (15 feet) in height and shall be treated to look like a building or facility typically found in the area.
- Satellite dish and parabolic antennas shall be situated as close to the ground as possible without compromising their function, preferably on the sides of buildings or on the ground on slopes below the ridge line.

Communities can impose placement and height requirements of building mounted antennas, such as the setback from the roofline of the building or the maximum square area of a building's facade that may be covered, etc.

3.2.5 Collocation Policies

Co-location is a technique which reduces the overall number of towers and wireless facilities in a community. Not all wireless carriers are willing to co-locate, however. This is due to the competitive nature of the industry as well as their separate technological requirements, although the latter is becoming less founded with the new advances in telecommunications technology.

Regulations which sponsor the spirit of co-location could include the following:

- All co-located and multiple-user telecommunication facilities shall be designed to promote facility and site sharing. To this end telecommunication towers and necessary structures (i.e. parking areas, access roads, utilities and equipment buildings) shall be shared by site users.
- Providers who choose not to co-locate their facility with another telecommunication facility shall provide a written explanation why the facility is not a candidate for co-location.

4.0 Conclusion: Part I

In summary, communities are guided by the section 704 of the Telecommunications Act of 1996. It is inevitable that wireless providers will seek to erect wireless facilities in or within the viewshed of the town of Athol. The town can regulate the siting of such facilities in terms of their location, height, setback, and design. However, the town should keep in mind that the wireless providers are mandated by the Federal Communications Commission to build-out their service and that the providers have specific technological design requirements. If the town allows wireless facilities by right, but town regulations conflict with the provider's technological requirements, the town must provide for a special exception (special permit) process to resolve that conflict. Under no circumstances may a community put into effect policies or regulations that effectively ban the construction of wireless facilities.

The town may approach the siting of wireless facilities in one of two ways, either on an application by application basis or through the development of a "wireless master plan"

The drawback of the first approach is that the community cannot foresee the total number of wireless facilities and their locations, the sum of which can have a greater visual impact on the town. The second approach is more forward looking. The community develops a "wireless master plan" which identifies sites which are best suited for telecommunications use. Service providers reference this plan, which serves as the jumping off point for further discussion and compromise. In addition, the community requires that the provider specify the total number and location of all towers and related facilities it wishes to construct in the community in advance.

The creation of a wireless master plan may appear time consuming. Communities, however, cannot claim to be short on information. Many regional planning agencies aid constituent communities by providing information on the industry. There are other avenues available, such as hiring outside consultants which specialize in planning for wireless facility siting.

The impetus of technology will force each and every community to deal with the issues raised by the wireless industry. Athol is in a position to approach this in a pro-active, rather than a reactive manner. But first, the community needs to decide whether it wishes to respond with regulations (ordinances), guidelines (policies), or a combination of the two (master plan) in order to reach its aspiration as a Mecca for the technology and telecommunications industry.

Appendix: Part I

AI. Definitions

BI. List of References

Appendix: Part I

AI. Definitions

Appendix AI

Definitions

Appendix AI: Definitions	
Antenna	means any system of wires, poles, rods, reflecting discs, or similar devices used for the transmission or reception of electromagnetic waves when such system is either external to or attached to the exterior of a structure. Antennas shall include devices having active elements extending in any direction, and directional beam type arrays having elements carried by and disposed from a generally horizontal boom that may be mounted upon and rotated through a vertical mast or tower interconnecting the boom and antenna support, all of which elements are deemed to be a part of the antenna.
Antenna	means any system of wires, poles, rods, reflecting discs, or similar devices used for the transmission or reception of electromagnetic waves when such system is either external to or attached to the exterior of a structure. Antennas shall include devices having active elements extending in any direction, and directional beam-type arrays having elements carried by and disposed from a generally horizontal boom that may be mounted upon and rotated through a vertical mast or tower interconnecting the boom and antenna support, all of which elements are deemed to be a part of the antenna. Antennas shall include cellular on wheels (COWs) and cellular on light trucks (COLTs) facilities; as well as dispatch carriers for Specialized Mobile Radio (SMR) services and Enhanced SMR (ESMR).
Antenna	is any system of poles, panels, rods, or similar devices used for the transmission or reception of radio frequency signals.
Antenna - Building Mounted	means any antenna, other than an antenna with its supports resting on the ground, directly attached or affixed to a building, tank, tower, building mounted mast less than 10 feet tall and 6 inches in diameter, or structure other than a telecommunication tower.
Antenna - Directional	(also known as a "panel" antenna) transmits and/or receives radio frequency signals in a directional pattern of less than 360 degrees.
Antenna - Ground Mounted	means any antenna with its base placed directly on the ground or a mast less than 10 feet tall and 6 inches in diameter.
Antenna - Ground Mounted	means any antenna with its base, single or multiple posts, placed directly on the ground or a mast less than 10 feet tall and 6 inches in diameter.
Antenna - Omni-directional	transmits and/or receives radio frequency signals in a 360 degree radial pattern. For the purpose of this Chapter, an omni-directional antenna is up to fifteen feet (15') in height and up to four inches (4") in diameter.

Appendix AI: Definitions	
Antenna - Parabolic	(also known as satellite dish antenna) means any device incorporating a reflective surface that is solid, open mesh, or bar configured that is shallow dish, cone, horn, bowl or cornucopia shaped and is used to transmit and/or receive electromagnetic or radio frequency communication/signals in a specific directional pattern. This definition is meant to include, but is not limited to, what are commonly referred to as satellite earth stations, TVROs and satellite microwave antennas.
Antenna - Parabolic	Parabolic antenna (also known as a dish antenna) is a bowl-shaped device for the reception and/or transmission radio frequency communications signals in a specific directional pattern.
Antenna - Portable	means any device used to transmit and/or receive electromagnetic or radio frequency communication/signals in a specific directional pattern, located on a portable or moveable base designed to be placed either for temporary or long-term use at a given site.
Antenna - Vertical	means a vertical type antenna without horizontal cross sections greater than one half inch in diameter.
Attached wireless communication facility	is a wireless communication facility that is affixed to an existing structure which is not considered a component of the attached wireless communications facility.
Co-location	see telecommunication facility - co-located.
Co-location	exists when more than one wireless communications provider mounts equipment on a single support structure.
Commercial Use	means a use that involves the exchange of cash, goods or services, barter, forgiveness of indebtedness, or any other remuneration in exchange for goods, services, lodging, meals, entertainment in any form, or the right to occupy space over any period of time.
Communication Appurtenance	Any antenna, device, wiring or equipment utilized in connection with the reception or transmission of electromagnetic radiation and which is attached to a pre-existing structure. A communication appurtenance does not include an antenna used by a federally licensed amateur radio operator or television antennas which are accessory to a residential use.
Communication Building	Any building utilized primarily for the installation and operation of equipment for generating and detecting electromagnetic radiation and which is accessory to a communication structure.

Appendix AI: Definitions	
Communication Structure	Any structure intended to support equipment used for the transmission and/or reception of electromagnetic radiation, including communication towers, monopoles, antennas, wiring or other devices attached thereto. This definition does not include antennas used by a federally licensed amateur radio operator or television antennas which are accessory to a residential use.
Communication Tower	Any multi-sided structure intended to support equipment used for the transmission and reception of electromagnetic radiation including antennas, microwave dishes, wiring or other devices attached thereto. This definition does not include an antenna used by a federally licensed amateur radio operator or television antennas which are accessory to a residential use.
Direct broadcast satellite service	(DBS) is a system in which signals are transmitted directly from a satellite to a small (not exceeding 18") home receiving dish. DBS competes with cable television.
Equipment building, shelter or cabinet	means a cabinet or building used to house equipment used by telecommunication providers to house equipment at a facility.
Ground Post Facility	is an antenna facility consisting of multiple posts mounted on the ground upon which sit antennas. If the height is up to 17 feet, it is treated as a Macro Facility and if over 17 feet, it is treated as a Monopole.
Inhabited Area	means any residence, any other structure regularly occupied by people, or any outdoor area used by people on a regular basis.
Lattice Tower	means a self supporting support structure, erected on the ground, which consists of metal crossed strips or bars to support antennas and related equipment.
Major skyline	means the top (crest) of the ridges bordering valleys.
Maximum Credible Earthquake	means the maximum earthquake predicted to affect a given location based on the known lengths of the active faults in the vicinity.
Monopole	Any cylindrical pole structure intended to support equipment used for the transmission and reception of electromagnetic radiation including antennas wiring or other devices attached thereto. This definition does not include an antenna used by a federally licensed amateur radio operator or television antennas which are accessory to a residential use.
Monopole	is a wireless communication facility which consists of a monopolar structure, erected on the ground to support wireless communication antennas and connecting appurtenances.

Appendix AI: Definitions	
NIER	means Non-ionizing Electromagnetic Radiation (i.e. electromagnetic radiation primarily in the visible, infrared, and radio frequency portions of the electromagnetic spectrum).
Public Service Use or Facility	means a use operated or used by a public body or public utility in connection with any of the following services: water, waste water management, public education, parks and recreation, fire and police protection, solid waste management, or utilities.
Public way	means and includes all public streets and utility easements, now and hereafter owned by the City, but only to the extent of the City's right, title, interest or authority to grant a license to occupy and use such streets and easements for telecommunications facilities.
Quasi-Public Use	means a use serving the public at large, and operated by a private entity under a franchise or other similar governmental authorization, designed to promote the interests of the general public or operated by a recognized civic organization for the benefit of the general public.
Readily Visible	means an object that stands out as a prominent feature of the landscape when viewed with the naked eye.
Related equipment	means all equipment ancillary to the transmission and reception of voice and data via radio frequencies. Such equipment may include, but is not limited to, cable, conduit and connectors.
Satellite Dish	means any device incorporating a reflective surface that is solid, open mesh, or bar configured that is shallow dish, cone, horn, or cornucopia shaped and is used to transmit and/or receive electromagnetic signals. This definition is meant to include, but is not limited to, what are commonly referred to as satellite earth stations, TVROs and satellite microwave antennas.
Satellite Earth Station	means a telecommunication facility consisting of more than a single satellite dish smaller than 10 feet in diameter that transmits to and/or receives signals from an orbiting satellite.
Silhouette	means a representation of the outline of the towers and antenna associated with a telecommunication facility, as seen from an elevation perspective.
Structure Ridge line	means the line along the top of a roof, or along the top of a structure if it has no roof.

Appendix AI: Definitions	
Telecommunication Facility	means a facility that transmits and/or receives electromagnetic signals. It includes antennas, microwave dishes, horns, and other types of equipment for the transmission or receipt of such signals, telecommunication towers or similar structures supporting said equipment, equipment buildings, parking area, and other accessory development.
Telecommunication Facility - Co-Located	means a telecommunication facility comprised of a single telecommunication tower or building supporting one or more antennas, dishes, or similar devices owned or used by more than one public or private entity.
Telecommunication Facility - Commercial	means a telecommunication facility that is operated primarily for a business purpose or purposes.
Telecommunication Facility - Mini	is an attached wireless communication facility consisting, but not limited to, the following unless located on a structure recognized as a Historic landmark: a. A single ground or building mounted receive-only radio or television antenna including any mast, for the sole use of the tenant occupying the parcel on which the radio or television antenna is located; with an antenna height not exceeding fifty feet (50'); b. A ground or building mounted citizens band radio antenna including any mast, if the height (tower, support structure, post and antenna) does not exceed seventy feet (70'); c. A ground, building, or tower mounted antenna operated by a federally licensed amateur radio operator as part of the Amateur Radio Service, if the height (post and antenna) does not exceed seventy feet (70').
Telecommunication Facility - Multiple User	means a telecommunication facility comprised of multiple telecommunication towers or buildings supporting one or more antennas owned or used by more than one public or private entity, excluding research and development industries with antennas to serve internal uses only.
Telecommunication facility - Non-commercial	means a telecommunication facility that is operated solely for a non-business purpose.
Telecommunications Tower	means a mast, pole, monopole, guyed tower, lattice tower, free-standing tower, or other structure designed and primarily used to support antennas. A ground or building mounted mast greater than ten feet (10') tall and six inches (6") in diameter supporting one or more antenna, dishes, arrays, etc. shall be considered a telecommunications tower.
Wireless communication facility	means an un-staffed facility for the transmission and reception of low-power radio signals.

Appendix: Part I

BI. List of References

Appendix BI

List of References

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Planning For Industrial Development

The Development of Telecommunications

Part II: Analysis Paper

prepared by:
Christine M. Lemay

prepared for:
Professor John Mullin
Regional Planning 691M

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Part II: The Development of Telecommunications in Athol

5.0 Introduction: Part II

Telecommunications, often referred to as the information superhighway, has enormous potential to stimulate economic development. Quoted from the document Kickstart Initiative, the following communications technology can be used to (Benton Foundation, 1997):

- "Creates new markets -- reaching potential customers, worldwide, is easier and cheaper;
- Eases entry into new markets, especially geographically remote markets, because it makes the playing field more level between companies of different sizes and in different locations;
- Provides new opportunities to undertake national programs such as health care, where the costs of personnel needed to manage a manual or disjointed automated system might be prohibitive;
- Reduces costs to buyers because of increased competition in procurement -- more suppliers are able to compete in an electronically open marketplace;
- Reduces costs to suppliers -- when suppliers can access, respond to, and receive orders online, their costs decline;
- Reduces the time needed to complete business transactions, particularly the time from product delivery to payment;
- Speeds the time to market -- linking business processes virtually eliminates time delays between steps and subprocess engineering, which results in seemingly seamless processing;
- Optimizes use of human resources -- employees are freed from many routine activities, giving them more time to focus on customer service and other duties;
- Reduces inventory requirements -- as demands for goods and services are electronically linked through just-in-time inventory and integrated manufacturing techniques, the need to stock inventory that might become obsolete declines;
- Reduces errors, time, and overhead costs in information processing -- requirements for reentering data are eliminated;
- Improves the quality of goods as a result of standardization of specifications and increased competition; and
- Increases the variety of available goods as a result of expanded markets and the ability to market customized products."

Telecommunications is a global business. It has the ability to expand a community's economic base and to open it up to wider markets. The following tables illustrate the global nature of the telecommunications industry in terms of exports, manufacturing revenue, the number of subscribers, service revenue, and number of employees (Tables 5.1 through 5.4).

Table 5.1
Top 10 Economies by Telecom Equipment Exports

Rank	Country	Telecom equipment exports (US$m)
1	Japan	18'823.8
2	United States	13'954.7
3	Germany	6'863.5
4	Singapore	6'058.2
5	Hongkong	5'970.1
6	United Kingdom	3'776.8
7	Korea (Rep.)	3'687.0
8	France	3'328.7
9	Malaysia	3'158.8
10	China	2'936.8

Source: Forthcoming ITU World Telecommunication Development Report 1996/97 (1994 data).

Table 5.2
Top 10 Equipment Manufactures

Rank			Telecom Equipment Revenue			
1995	1994	Company	US$m	% Change 1994-1995	As % of total sales	Foreign Sales %
1	1	Alcatel (France)	20'053.8	-5.1%	62.4%	77.0%
2	2	Motorola (USA)	16'660.0	15.8%	61.6%	63.0%
3	3	AT & T (USA)	15'564.0	9.0%	19.6%	26.0%
4	4	Siemens (Germany)	13'669.2	-5.4%	22.1%	57.4%
5	5	Ericsson (Sweden)	13'423.3	19.9%	96.9%	90.8%
6	7	Nortel (Canada)	10'143.0	23.3%	95.0%	89.0%
7	6	NEC (Japan)	10'049.3	6.0%	27.2%	27.0%
8	8	Nokia (Finland)	8'525.3	27.8%	101.1%	91.2%
9	10	Fujitsu (Japan)	6'641.6	2.6%	15.4%	29.9%
10	9	Bosch (Germany)	3'777.4	-29.2%	16.1%	54.0%
		Top 10 total	**116'398.6**	**15.9%**	**36.0%**	**49.0%**

Source: Forthcoming ITU World Telecommunication Development Report 1996/97 (1994 data).

Table 5.3
Top 20 world cellular markets by subscribers

Rank	Economy	Subscribers (million) 1/1/96
1	United States	33.786
2	Japan	10.204
3	United Kingdom	5.000
4	Italy	3.923
5	Germany	3.750
6	China	3.629
7	Australia	2.500
8	Canada	2.400
9	Sweden	2.025
10	Korea (Rep.)	1.641
11	France	1.400
12	Brazil	1.286
13	Thailand	1.088
14	Finland	1.039
15	Norway	0.982
16	Spain	0.944
17	Malaysia	0.873
18	Denmark	0.819
19	Taiwan-China	0.770
20	Hongkong	0.763

Source: ITU/BDT World Telecommunication Indicators database.

Table 5.4
Top 15 telecommunication operators by telecommunication service revenue

		Telecom service revenue		Net Income after tax		Employees	
Rank	**Company (Country)**	**Total (US $m)**	**Change 1994-1995**	**Total**	**Change**	**Total (000's)**	**Change 1994-1995**
1	NTT (Japan)	84'080	22.0%	2'267	203.8%	235	-5.2%
2	AT&T (United States)	47'277	8.9%	-139		77	-7.5%
3	Deutsche Telekom (Germany)	46'151	17.4%	3'679	65.9%	220	-2.2%
4	France Télécom (France)	29'613	15.3%	1'843	4.0%	168	-0.1%
5	BT (United Kingdom)	22'785	7.2%	3'142	18.3%	131	-4.9%
6	Telecom Italia (Italy)	18'463	2.3%	1'071	19.1%	90	-5.0%
7	BellSouth (United States)	17'886	6.2%	-1'232		88	-4.9%
8	GTE (United States)	17'374	0.1%	-2'144		85	
9	MCI (United States)	15'265	14.4%	548	-31.1 %	50	23.9%
10	Sprint (United States)	13'556	7.1%	393	-55.9%	52	2.2%
11	Bell Atlantic (United States)	13'430				62	
12	Ameritech (United States)	13'428				65	
13	Nynex (United States)	13'407				66	
14	SBC (United States)	12'670				59	
15	US West (United States)	11'746				62	

Source: ITU/BDT PTO database.

Summary of Tables 5.1 through 5.4:

Table 5.1: Top 10 Economies by Telecom Equipment Exports

The United States ranks second of all countries in the export of Telecommunications equipment, valued at $13,000,954.70 annually. This is 1.4 times less than that brought in by Japan, the highest ranking country for telecommunications export. Comparatively, the U.S. brings in more than twice the revenue in export than the third ranking country, Germany.

Table 5.2: Top 10 Equipment Manufactures

Of the top ten equipment manufacturers, Germany, Japan and the U.S. each hold 2 of those ten positions. The U.S. has held steady for the second and third ranks between the years 1994 and 1995. Motorola (USA) has seen a 15.8% increase in total revenue, which accounts for 61.6% of their total sales. AT & T has seen a 9.0% increase in telecommunications equipment revenue, accounting for 19.6% of their total sales. 63% of Motorola's telecommunication equipment sales are to foreign countries, compared to 26.0% for AT & T.

Table 5.3: Top 20 world cellular markets by subscribers

Of the top 20 world cellular markets, which is measured by the number of subscribers, the U.S. ranks number one, followed by Japan. Over 33 million Americans subscribe to cellular providers. This is more than triple the number of subscribers in Japan (10.204 million).

Table 5.4: Top 15 telecommunication operators by telecommunication service revenue

Of the top 15 telecommunication operators, the U.S. holds 11 ranked positions. The companies include AT & T, Bell South, GTE, MCI, Sprint, Bell Atlantic, Ameritech, Nynex, SBC, and U.S. West. Japan is ranked number one in terms of telecommunications service revenue and has seen a 22% growth in revenue between 1994 and 1995. The U.S.'s top ranking company, AT & T, experienced a mere 8.9% increase in service revenue. This is probably due to the FCC's regulations and the subsequent competitiveness of telecommunication service providers. NTT, based out of Japan, employs 235,000 persons. AT & T employs only 77,000. But if all employees in U.S. companies within the top 20 were totaled, the number of employees would equate to 666,000 persons. Revenue for the top U.S. companies is approximately $171,005,039.0, compared to Japan's revenue of $84,000,080.

The statistics show that there are markets that can be tapped into. There are a variety of new service opportunities for telecommunications firms, listed in Table 5.5.

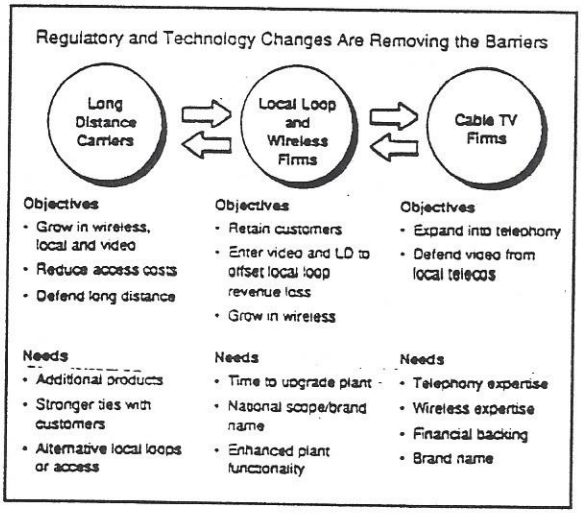
Table 5.5: Applications for Telecommunications

	Entertainment	Communications/Transactions	Information
Consumer	Games Video on demand Gambling Movies	Home shopping Health/prescriptions Video telephony Home banking	Directories Information retrieval Customized news/sports Home shopping Electronic classifieds
Business		Video conferencing/training Telecommuting Ubiquitous e-mail/v-mail Telemedicine/teleradiology Screen sharing/grouper Digital service bureau Handled computing Video Messaging	Electronic publishing Data retrieval Document/image control Information confirmation Operational support Multimedia medical records Desktop training

Source: Private Industry Council, 1996

Any community seeking to enter the communication industry's market should be prepared for fierce competition amongst the traditional service providers due to the deregulation and increased competition spurred by the Telecommunications Act of 1996. The convergence of multimedia types (i.e. voice, text, graphic and data) will "have an impact on both consumers and providers of telecom services and products, and on whether individual companies will rise or fall in this market" (Massachusetts Telecommunications Council, 1996). Figure 5.1 shows the conflicting competitive objectives and needs between long distance carriers, local loop and wireless firms, and cable TV firms (Source: Private Industry Council, 1996).

Figure 5.1 Competitive Objectives Between Service Providers



Currently, businesses in Athol related to telecommunications include the following:

Table 5.6 Businesses related to Telecommunications

Service Providers	Product Providers (Hardware & Software)	Spin-offs
Athol Orange Community Television Inc.	Flashback Software	37 Design Group, Inc.
TIAC - The Internet Access Company, Inc.	Group Tech Inc.	Creative Video Productions
	C Electronics	Crocker Communication Center
		B Electronics
		James Karan Video Productions
		Millers River Computers
		Mogel Security
		NFP Computers
		Personnel Communications
		Personnel Communications Corp.
		Quabbin Cellular & Paging Services
		RCP Electric
		Rowe Computer Services

There are 7 businesses/organizations in Athol that have a presence on the World Wide Web. On-line services are a significant part of the communications industry. By placing themselves on the Web, these businesses and organizations are buying into the concept of multimedia marketing and advertising.

Table 5.7 Organizations and Businesses with Web Sites

Athol Downtown Partnership • http://www.tiac.net/users/egchase/adp.htm	*Inquiry Systems Co.* • Advertising - Direct Mail, Desktop Publishing Services, Marketing Programs & Services • E-mail: inqsys@inqsys.com • URL: http://www.inqsys.com
DAZ Productions (A Zanga Enterprise Division) • audio - video - theatrical production company • http://www.zanga.com/index.html	*Millers River Community Development Corporation (CDC)* • http://www.millersriver.org/
Financial Data Research Management • Financial Data Research Management provides business accounting and tax services. • http://www.zanga.com/index.html	*Stefan Maier - Organ builder* • Musical Instruments, Pipe Organs • E-mail: pipeorgans@hepton.tiac.net • URL: http://www.tiac.net/users/hepton
Foster-Healey Real Estate, Inc. • Real Estate, Real Estate Industrial & Commercial • E-mail: janiscrs@tiac.net • URL: http://www.tiac.net/users/janiscrs	

6.0 Where is Athol? What does it have to offer?

New and expanding industries in communications, those which are able to take advantage of rural locations for their back-office activities, often look for social and cultural amenities offered by a town. Prior to consideration, the information network on which they rely for information gathering and exchange must be present for them to consider re-locating to pastoral, quiet paced settings. So, what does Athol and the Montachusetts region have to offer?

Athol, settled in the 1790's and located in the North Quabbin region of West Central Massachusetts, has the potential to fulfill an industry's wildest dreams! It is not only bordered by other rural-like communities such New Salem and Orange on the west, Royalston on the north, Phillipston on the east, and Petersham on the southeast, but its proximity to larger economic hubs is not far at all. Table 6.1 provides the distance from Athol to major towns and cities in Massachusetts.

Table 6.1 Distance to Economic Centers

Town/City	Distance from Athol (miles)
Fitchburg	25
Worcester	38
Boston	72
New York City	182

Source: Department of Housing and Community Development, Community Profiles.

The transportation network is well defined, affording easy and safe access to and from Athol. Automobile access includes: State Route 2, which runs across northern Massachusetts; State Route 2A; U.S. Route 202 and State Route 32, which run N-S from New Hampshire to Springfield and to U.S. Route 20, respectively; State Route 140, and; Interstate 190, connecting the region to Worcester. The Springfield Terminal Railway, which provides freight rail service, accesses the network of intermodal facilities serving central and eastern Massachusetts.

The Orange Municipal Airport is a non-precision airport, but does have the technology to accommodate for instrument approaches. It has 2 asphalt runways (5,000' x 150' and 4,998' x 150'). Such a service could be invaluable to product-light, value-heavy products.

Beyond its municipal and infrastructure services, Athol contains both urban and rural characteristics. Its curving downtown street invites the shopper to explore, and is of human proportion in scale. There are a multitude of recreational activities to engage in, such as: camping, hunting, and fishing.

Part of the economic dilemma that plagues Athol is its strong manufacturing base, namely metalwork

manufacturing. With the industrial trend shying away from traditional manufacturing to more service oriented industries (which will increasingly rely heavily on advanced telecommunications networks) Athol, nicknamed "Tool Town, U.S.A.", must carve out a new name for itself if it wishes to thrive and grow in the "Information Age".

6.1 Demographic Analysis

The demographic analysis of Athol looks at the economic base and labor force characteristics of the town, and the changes therein over time. This information is analyzed to determine the inherent strengths and weaknesses of the community. When compared to the labor force characteristics and skills typical of those employed in the communications industry (see Section 6.2), those which should be fostered or nurtured are highlighted. The following is a summary of Tables 6.1.1 through 6.1.23, provided in Appendix A.

Summary of Tables 6.1.1 through 6.1.23:

Table 6.1.1 Persons by Age / Persons by Gender for State, County, and Athol (1990 US Census)

The percentage of persons in a each age category shows no significant difference between Massachusetts, Worcester County, and Athol. The ratio between men and women between the three is also approximately the same, averaging 51.6% for females and 48.4% for males.

Table 6.1.2 Persons by Age / Persons by Gender for Athol (1970, 1980, 1990 US Census)

As of 1980, there is an increase in persons under the age of ten and those between the ages of 25 to 34 years of age. This corresponds to a decrease in the age cohorts between 10 and 24 and 40 and 85 years of age. Characteristics of the population between ages 24-34 include an increased proficiency with computers and information technology.

Table 6.1.3 Educational Attainment for State, County, and Athol (1990 US Census)

A full 25% of Athol's population, aged 25 and over, never received a high school diploma. Compare this to the state's percentage of 20% and Worcester County's percentage of 23%. However, this may be misleading because 41% of the population received a high school diploma or equivalency compared to the county's 31% and the state's 30%. The state, on the whole, has a higher percentage of college graduates (17%) than the county (14%) and Athol (8%). This is quite remarkable. In terms of Graduate level degrees, Athol's percentage is 4%. This is remarkably lower than the state's average of 11% and the county's 8%.

The percentages for the age group 25 years and over are more significant than those percentages of 18 years and over (although the same trends exist) because Athol has a higher percentage of persons 25 years to 34 years than it does from 18 to 24.

Table 6.1.4 Educational Attainment for Athol (1970, 1980, 1990 US Census)

Despite the fact that fewer of Athol residents graduate from high school and are less likely to obtain a higher education degree, there is a -1.76 decrease in the number of persons who did not receive a high school degree between the 1980 and 1990. This negative decrease is a positive trend. It means that a greater percentage of the population is obtaining a high school degree.

There is a decrease, between these same years, of persons graduating with a masters's degree (-1.27%).There is a strange fluctuation between the years of 1970 to 1990. There is an increase in non-high school graduates between 1970 and 1980, which is reversed between 1980 and 1990. The reverse is true for bachelor and master degree students. Between 1970 and 1980, a greater percentage of the population held a master's degree than between 1980 and 1990. What could account for the decrease in persons obtaining high school and higher education between the years 1980 and 1990 than between 1970 and 1980? (My guess is the increase in school tuition and the attention of the federal government directed elsewhere).

Table 6.1.5 Gender by Labor Force Status for State, County, and Athol (1990 US Census)

The table breaks down the total number of person who are 16 years and over by gender and labor force status. All three comparison areas share similar percentages for the total percent of males 16 years and over (47.33%). Of those males, approximately 75.78% are in the labor force, whereas 24.22% are not. Across the board, the three geographical units share similar ratios (%) of males to females for persons 16 years and older.

The percentage of females, both in (~60%) and out of the labor force (~40%,) are similar for Massachusetts and Worcester County. Athol's percentages are quite different, pointing to a lower presence of women in the labor force (52.7% in the labor force and 47.3% not in the labor force).

What this indicates is that out of all persons 16 years and over, a smaller percentage of Athol's population participates in the labor force (62.9% of all persons 16 years and over are in the labor force.), and those persons are most likely of the male sex. Compare this to the state's and county's percentages, 67.8% and 67.4% respectively.

Table 6.1.6 Gender by Labor Force Status for Athol (1970, 1980, 1990 US Census)

In general, there is an increase in the percentage of persons, male and female (aged 16 years and over) combined, participating in the labor force between the years 1970 and 1990.

Female presence in the labor force has increased from 43% in 1970 to 53% in 1990. Males, on the other hand, increased only one percent between 1970 and 1990. There was a minute negative fluctuation between 1970 and 1980 where the percentage of males in the labor force actually dropped 2%.

Table 6.1.7 Female 16 years and over by Presence and Age of children and Labor Force Status for State, County, and Athol (1990 US Census)

In 1990, women aged 16 years and over, with children under 18 years of age, had a strong presence in the work force. In Massachusetts, 60.31% of these women participated in the labor force. Worcester County's percentage was 58.97. Athol was significantly lower than the states average, with only 52.65% participating in the labor force.

Table 6.1.8 Female 16 years and over by Presence and Age of children and Labor Force Status for Athol (1970, 1980, 1990 US Census)

In 1990, 44% of all females over the age of 16 had children under the age of 18. Women with children accounted for 17% of all women aged 16 years and over, a figure that rose 5% between 1970 and 1990.

Women with children who did not participate in the labor force in 1990 equated to 9% of the females aged 16 years and over, a percentage that dropped from the 1970 level of 17%. This indicates that the percentage of women with children, when compared to all women aged 16 years and over, are frequently joining or returning to the labor force, despite the added responsibility and burden of having children.

Table 6.1.9 Gender by Work Status for State, County, and Athol (1990 US Census)

When comparing 1990 U.S. Census data for Athol to the state and county, there was a distinct difference in the percentage of persons 16 years and over (male and female combined) who did and did not work in 1989. 66.8% of the persons, aged 16 years and over, in Athol, worked in 1989; 33.2% did not. Of those who did work, approximately 37% were male and 30% were female. 33.2% did not work, of which 10% were male and 23% were female.

The state and county show similar percentages, which combined, roughly equate to 73% who did work in 1989 and 23% who did not. The break down of male to female worker percentages is also approximately the same. 38%-39% of the persons who worked in 1989 were male, 34% female. Of those aged 16 years and over, who did not work in 1989, 9% were male, 18% were female.

A common characteristic shared by the three geographical areas is that, of all persons 16 years and over, a larger percentage of those who did work in 1989 were men, despite the fact that the ratio of women to men was greater in the state, the county, and Athol.

Table 6.1.10 Gender by Work Status for Athol (1970, 1980, 1990 US Census)

N/A - 1970 and 1980 Census Data not available for comparison over the three time periods.

Table 6.1.11 Transportation and Commuting Patterns for State, County, and Athol (1990 US Census)

For Massachusetts, Worcester County, and Athol, people tended to work in their state of residence, and within their county of residence (1990 U.S. Census data). Whether or not a person lived and worked in the same place depended on the geographical scale. For Massachusetts, people living in a place tended not to work in their place of residence. The county exhibited a 50/50 split for those living in a place and working in or out of their place of residence. Athol showed a further shift in this trend, with 40% of persons living in a place working in their place of residence, as compared to 35% working outside of their place of residence. This trend could be attributed to the availability of public transportation. The Massachusetts' percentages may be misleading because urbanized areas are more densely populated and generally provide several means of public transportation.

Workers 16 years and over relied heavily on private transportation. In 1990, 11% of MA's workers car pooled, compared to Worcester County's 12% and Athol's 16%. Car-poolers generally did not travel with more than 2 persons per vehicle. 8% of the workers in Massachusetts used public transportation. Only 15, which is less than 1%, workers in Athol used public transportation. This is not surprising...rural towns generally do not have extensive public transportation networks.

64% of the workers in Athol took 20 minutes or less to travel to work, compared to 47% of workers throughout the state and 51% or the workers in Worcester County. Taking the mean travel time to work for the three comparison areas equalizes the disparity in travel times, with a range between approximately 19 and 23 minutes.

Table 6.1.12 Transportation and Commuting Patterns for Athol (1970, 1980, 1990 US Census)

In Athol, between the years of 1980 and 1990, a smaller percentage of workers aged 16 years and over worked in their county of residence. In fact, in 1980, more than 3/4 of the workers worked outside of their place of residence. Between 1980 and 1990, one sees a greater percentage of persons finding employment within the town. This may point to an economic upturn which created more or better job opportunities.

Between 1980 and 1990, a greater percentage of the workers were driving alone, corresponding to a drop in car pooling. Over the 10 year period, the mean travel time increased from 13 minutes to 19 minutes, which may be indicative of the increase in the number of vehicles on the road.

Table 6.1.13 Employed persons 16 years and over by Industry for State, County, and Athol (1990 US Census)

Many of the percentages for number of employed persons 16 years and over by industry are similar. It is notable that the three comparison areas all have relatively equal percentages for persons employed in retail trade. The state's and county's most important industry, in terms of employment percentages, was manufacturing. It is noteworthy that Athol employed a greater percentage of its workers in manufacturing (33.5%), as compared to the state's 17.5% and the county's 23.3%.

In 1990, only 2.4% of MA workers were employed in the "communications and other public utilities" industry. That percentage was 2.2% for the county and 2% for Athol.

Table 6.1.14 Employed persons 16 years and over by Industry for Athol (1970, 1980, 1990 US Census)

Between 1970 and 1980, the industries which gained the most in terms of percentage of total employed persons 16 years and over was in health services. Manufacturing saw the greatest loss. In 1970, Athol employed 52% of its workers in manufacturing positions. In 1980, this saw a 4% increase to 56%, which quickly plummeted to 34% in 1990. This reflects the trend in Massachusetts in which towns are rapidly loosing their manufacturing and industrial base to countries overseas, southern states, and the increasing popularity of the service industries.

Table 6.1.15 Industry Location Quotient

A location quotient is the comparison of an industry between two geographical areas, where one geographical area resides within the other.

The table shows Athol's share of an industry compared to Massachusetts and to Worcester County. For this analysis, the number of employed persons, 16 years and over, was used as the comparative figure. A location quotient greater than one means that Athol holds a greater share of the industry compared to its counterpart and is probably exporting the industry to other areas. If the quotient equals 1, the industry is probably not being exported or imported but is sufficient to support the community. If less than one, the community is more likely to import that industry.

Industries with location quotients greater than 1.00, for both the county and the state:

- Manufacturing, nondurable goods
- Manufacturing, durable goods

Industries with location quotients greater than 1.00, for the state, but not the county:

- Health services (less than 1.00 when compared to the county)

Industries with location quotients greater than 1.00, for the county, but not the state:

- Personal services (less than 1.00 when compared to the state)
- Public administration (less than 1.00 when compared to the state)

Industries with location quotients less than 1.00, for both the county and the state:

- Mining
- Construction
- Transportation
- Communications and other public utilities
- Wholesale and Retail trade
- Finance, insurance, and real estate
- Business and repair services
- Entertainment and Recreation services
- Educational services
- Other professional and related services

The quotients, showing the relative strength or weakness of an industry with Athol, provide a starting point for capitalizing on healthy industries or shoring up the weaker ones.

Table 6.1.16 Employed persons 16 years and over by Occupation for State, County, and Athol (1990 US Census)

Athol employs a smaller percentage of persons 16 years and over in the Managerial and professional specialty occupations and the Technical, sales, and administrative support occupations than either the state or the county.

However, Athol employs a higher percentage of persons in Service occupations, including Protective service occupations and Service occupations (excepting those related to protective and household). The town also has a greater percentage of employees in the Farming, forestry and fishing occupations, Precision production, craft and repair occupations, and Operators, fabricators and laborer occupations. The differences are not overly significant. There is one exception to this, however, and that is in the percentage of employed persons for Machine operators, assemblers and inspectors (MA - 5.6%; County - 7.4%; and Athol - 14.5%). These findings support the fact that Athol's two strongest industries are Manufacturing and Retail, both of which typically employ persons from these related occupations.

Table 6.1.17 Employed persons 16 years and over by Occupation for Athol (1970, 1980, 1990 US Census)

The most significant increases in percentages of persons employed by occupation between 1980 and 1990 included Sales occupations and Service occupations (excepting protective and household). The most important occupation in Athol, that of Machine operators, assemblers, and inspectors, decreased 13% in terms of the percentage of persons employed. Other occupations which saw a decrease in percentage of persons employed, however small, included Precision production, craft and repair occupations and Handlers, equipment cleaners, helpers and laborer occupations. The other occupations either remained stable, or saw a percentage increase of 1-3%.

Table 6.1.18 Employed persons 16 years and over by Class of Worker for State, County, and Athol (1990 US Census)

The class of worker analysis breaks down the type of employment opportunities by private, public, or self employed classifications. In 1990, a majority of employed persons aged 16 years and over were Private for profit wage and salary workers (>70% of employed persons for all three comparison areas). There was a greater percentage of persons employed in public, local government positions in Athol than in Massachusetts and Worcester County. There was also a greater percentage of employed persons who were self employed in Athol.

Table 6.1.19 Employed persons 16 years and over by Class of Worker for Athol (1970, 1980, 1990 US Census)

Between the years 1970 and 1990, there has been some significant shifts in the percentage of persons employed by the Classes of Worker. For example, in 1970 9% of employed persons in Athol were classified as state/federal government workers. By 1990, one can see the disappearance of these positions for the percentage dropped to 5%. The percentage for employed persons classified as Private for-profit wage and salary workers decreased 11% between 1980 and 1990, although this remained the strongest category for percentage of employed persons.

Table 6.1.20 Household Incomes for State, County, and Athol (1990 US Census)

The median household income in 1990 was $36,952 for Massachusetts. This was significantly more than the median household income for Athol in 1990, which was $27,095. The per capita income showed the same difference, with $17,224 for Massachusetts and $12,444 for Athol. Athol's median household income and per capita income was also less than the figures for Worcester County. In Massachusetts and Worcester County, the percent of households earning more than $60,000 annually was 24% and 21% respectively. Only 10% of Athol's households could boast the same. The percentage of households earning less than or equal to $25,000 in Athol was consistently greater than or equal to the percentages for the county and the state.

In general, the state on the whole seemed to fair better in terms of higher household incomes. Worcester County faired slightly less well, and Athol showed a disparity in household income levels when compared to the state.

Table 6.1.21 Household Income for Athol (1970, 1980, 1990 US Census)

Although Athol tends to have a greater percentage of households with incomes less than $25,000 when compared to the county and the state, there was a significant trend within the town itself between the years 1980 and 1990. In all income groups earning less than $30,000 (except those earning between $10,000 and $12,499), there was a decrease in the percentage of households falling into these categories. This points to the fact there was greater percentage of households earning more than $25,000 a year. Despite inflation of the dollar, this probably meant a better standards of living.

Table 6.1.22 Age of householder by Household Income for State, County, and Athol (1990 US Census)

There is a curve in the ages of householders for Worcester County and Massachusetts. The smallest percentage of households had householders under 25 years. The curve peaked for the ages 25 to 44, only to drop off gradually with increasing age. Athol followed this pattern up until the age group starting at 45. Instead of showing a steadily decreasing percentage of households, the numbers flattened out at 14% for the last few age brackets.

None of the households with householders aged 25 years or less earned more than $50,000.
Households where the age of the householder was over 55, across the three comparison areas, seemed to have comparatively equal household percentages for each of the income ranges. For the households with householders between the ages of 25 and 54, the discrepancy in the percentage of households by income bracket became apparent for incomes greater than $50,000. Athol had the least household percentage share.

Table 6.1.23 Poverty Status by Sex and Age for State, County, and Athol (1990 US Census)

In 1990, Massachusetts, Worcester County, and Athol shared the following poverty status characteristics:

Of those persons for whom poverty status was determined as above the poverty level, a greater percentage were women (gender ratio of male:female ~ 49%:50%).

Of those persons for whom poverty status was determined as below the poverty level, a greater percentage were women (gender ration of male:female ~ 40%:60%).

This points out that although women and men may share similar percentages when it comes to being above the poverty level, those for whom poverty status has been determined as under the poverty level in 1990 were more likely to be women.

6.2 Labor Force Characteristics and Skills of Telecommunications Workers

In 1996, the Private Industry Council (Private Industry Council, 1996) produced a report entitled "Telecommunications Industry: Bay Area Labor Market Analysis, 1996". The purpose of the report is to "enhance the quality and utility of telecommunications labor market information" (Private Industry Council, 1996). Although the Bay Area, located in California, is far removed and more advanced in information technologies when compared to the rural communities of Western Massachusetts, the conclusions reached concerning the characteristics and skills of telecommunications workers are transferrable.

According to the report, telecommunications workers are defined as "people who work in firms providing telecom services, providing products (hardware and software) used to provide telecom services, and internal telecom service departments of large organizations." They are either service providers or product suppliers.

Table 6.2.1 Services provided by Service and Product Oriented Organizations

Type of organization	Services provided
Services	provide telecommunications services to end-users (e.g. voice and data via wire, fiber, cable, or wireless) or services to businesses (e.g. system consulting, design, installation) or internal corporate telecom services.
Products	create products (hardware and software) used to deliver telecommunications services (e.g. phones, modems, PBXs, LANs, cell transmitters

Source: Private Industry Council, 1996

Examples of what constitutes a service versus a product supplier are as follows (Private Industry Council, 1996):

Table 6.2.2 Service Providers Versus Product Providers

Service Providers	Product Providers (Hardware and Software)
Communications Services:	**Network equipment:**
• Phone companies	• switches, bridges, routers, modems
• Cable TV	
• Cellular	Customer premise equipment
• Internet access	Network monitoring systems
System Installation:	Broadcast (receiving equipment)
• Central office equipment	Satellite communication systems
• PBX systems	Communications interfaces
• Building wiring	Communications security
• LANs	Data concentration
• WANs	E-mail systems
Systems Maintenance	Other
System Design	

Should Athol, or the Montachusetts region, pursue the development of telecommunications, the primary focus will initially be the development of infrastructure. With infrastructure in place, focus will then shift to the development of hardware/software and creating adaptive communications products that operate across different systems because "...even though new communications services are facility and equipment intensive, once the fiber/cable/cellular/satellite networks are in place, it will be software that creates the ongoing stream of new telecommunication applications" (Private Industry Council, 1996). As the saying goes, "build it and they will come". Build the communications infrastructure, and the opportunities to develop an economy based on communication services will become manifest.

Occupations:

The study identified five occupations, each with their attendant characteristics and skills. They are as follows (Private Industry Council, 1996):

Table 6.2.3 Telecommunications Occupations and Rating of Importance to Employers

		Occupations rating by firm type*		Skill categories and Examples
Occupation	**Job description**	**Products**	**Services**	
Telecommunication Sales	Sales people with telecom expertise capable of handling an increasingly more complex and specialized sale.	4.9	3.3	See Appendix B.
Customer Service	People to provide a high level of customer care, including selling skills, to differentiate on supplier from another in commodity markets.	4.3	3.0	See Appendix B.
Installation Technicians	People to install new telecom systems based on new technology (e.g. CAT-5 fiber optic installers).	3.5	3.9	See Appendix B.
Application Engineers	People who understand both the telecom technology and customer environment well enough to design solutions for specific customer needs (e.g. an order entry system for a mobile sales force).	3.2	3.7	See Appendix B.
Telecom Engineers	People to design new telecom hardware and software systems.	3.4	3.3	See Appendix B.

Source: Private Industry Council, 1996.
* Scale: 1=Not critical, 5=Critical

Four of the five occupations are "customer facing", meaning interpersonal skills are extremely important. Companies providing the same services differentiate themselves by the quality of customer service.

A college degree is required for two of the five occupations (Application Engineers and Telecom Engineers). However, because more people are attending colleges and universities than was previously the case, jobs that do not require an advanced education will increasingly be filled by those who hold a higher education degree.

The U.S. Census' show that Athol, when compared to the state of Massachusetts and Worcester County:

- had a higher percentage of high school graduates for both persons 18 years and over and 25 years and over.
- had a relatively equal percentage of persons who obtained an Associates degree for both persons 18 years and over and 25 years and over.
- had a lower percentage of college graduates (Bachelor's and Associates degree) for both persons 18 years and over and 25 years and over.

However, if Athol is scrutinized on the basis of its internal change between 1970 and 1990, one discerns the following trends:

- A greater percentage of persons graduated from high school in 1990 than in 1980 for both persons 18 and 25 years of age and over.
- The same trend occurs between 1980 and 1970 for persons 25 years and over.
- The percentage of persons obtaining a masters, or even a bachelor's degree dropped between 1970 and 1980, and between 1980 and 1990 for persons 25 years and over. This, however, is not true for persons 18 years and over.

As mentioned above, jobs that do not require a higher education degree are being filled by persons with some college experience. Although not familiar with the education system in Athol, the school system should increasingly focus on graduating more students from high school and instilling in them the love of learning. Computers and technical training should incorporated into all schools. There are a variety of college resources available to the Montachusetts region, perhaps co-operative partnerships could be developed.

The skill identified in the Private Industry Council's report are not locality driven, but industry driven. They can therefor be translated into skill requirements for the telecommunications industry as a whole.

Table 6.2.4 Rating of Skill Requirements by Occupation Type

Skill	Occupations (skill requirements ranked by importance, where 1=Most Important)				
	Telecom Sales	**Customer Service**	**Installation Technician**	**Application Engineer**	**Telecom Engineer**
Good interpersonal skills	1	1	2	3	3
Current technical skills	2	2	1	1	1
Prior sales success	3				
Self-marketing ability	4	4	5		
Maintain a strong personal network	5			6	5
Good references	6	3	3	5	4
College degree	7		6	2	2
Previous experience		5			
Dependable/Good work ethic			4		
Relevant work experience				4	6

Source: Private Industry Council, 1996.

The skills listed above are not difficult to obtain. In fact, many of them are not "taught", in the traditional sense, in any classroom. These are personal skills that are gleaned from life experience and self-exploration. Universities, technical schools, and community colleges offer environments that foster this type of development.

The one criteria that often stymies the best efforts of those seeking employment is "previous experience". If this is the case, especially in the technical fields, then why aren't labor force participants provided with the training that they need? This issue is discussed later in Section 7.3.3 (Systems Approach).

The report identifies Telecom Skill "demand drivers", or those technological advances which will effect the labor market demand for different skill needs.

Table 6.2.5 Demand Drivers

Rank	Emerging Development
1	Online Services Growth
2	Fiber Optics
3	Changing Nature of Work
4	Integration of Technologies
5	Wireless Communication
6	High Bandwidth Services

Source: Private Industry Council, 1996.

The "demand drivers" influence the set of skills that will be required. Today, each of these are familiar terms. Five years ago, however, these were "new" technologies or concepts. As computers and computer technology becomes integrated into the education system, these and future emerging developments will become inherent knowledge to the future labor force. Persons who did not grow up with these new communication technologies may find adjusting to the "information age" difficult. When an organization or business upgrades its organization to incorporate the use of computers, I feel it is the management's responsibility to provide hands-on training by (patient) professionals.

7.0 Infrastructure Needs and Costs

7.1 Infrastructure Requirements

There are a wide variety of wireless technologies to choose from, which is not surprising considering the industry predicts that wireless data will be one of the fastest growing sectors of the wireless industry (Office of Technology Assessment, 1995). Wireless data can be defined as the "wide array of radio based systems and services centered around pagers, portable computers, personal Digital Assistants (PDA's) and specialized applications for business" (Office of Technology Assessment, 1995).

Aspects which factor into choice include the installation costs of infrastructure (which equates directly or indirectly into monthly user fees), the capabilities of the technology, the need for supporting equipment (i.e. hand-held phones, lap top computers, etc.), and the inter-operability between wired and wireless networks. Table 7.1.1 lays out this information. Keep in mind that while the capabilities of wireless technologies are advancing, the prices are dropping. It is useful to compare the installation/user fee costs to the average 1996 installation and monthly user fees of the traditional wire-line telephone service, which is $1,000.00 per home passed. This translates into approximately $30.00 per month (National Research Council, 1996).

Table 7.1.1 Wireless Technology Types and their Use

Technology	Installation / User Fees	Capabilities	Applications	Required Equipment
Asynchronous Transfer Mode (ATM)		A fast packet, switched cell relay technology. Data switched to wire-line network. Packets of 53 bytes. Operates at 2.4 billion bits per second	Multimedia capabilities	Terrestrial towers for transmission. Wired or wire-less computer with modem Switching station with wired connections Adaptive software to translate and retain integrity of information.
NASA's Advanced Technology Satellite (ACTS)	In the future, costs are predicted to be $25 a month with $1 per minute of usage.	Reaches persons in rural areas not reached by cellular service.	Multiple low speed connection, Four 155 Mb/s full duplex connection, or One 622 Mb/s full duplex connection.	Satellite connections. Transmission tower. Computer/server to receive data. Car phones with antenna built into vehicle (hand held phones not strong enough to receive the satellite signal).
Travler (ARPA)		A packaging system software and services for mobile computers. Supports adaptive agents, data consistency.	Database support, predictive caching of files, real time modeling and simulation, resource discovery, security, user-level replication and virtual networking.	Satellite connections. Transmission tower. Computer/server to receive data.
Low Earth Orbit Satellites		Network of low-orbiting satellites permitting the use of hand held devices. Designed for low speed, data services.		

Technology	Installation / User Fees	Capabilities	Applications	Required Equipment
Large Earth Orbit Satellites	Handsets - $500 to $3,000. Calls - $3.00 per minute.	Designed to provide both voice and data services. Will use a dual mode phone that switches between cellular and satellite coverage. Global coverage with service provided by a single provider.		
Two-way Messaging (see Packet Radio Networks and Narrow band Personal Communications Services below)	Pagers - $50-$500. Radio modems - up to $800 Service - $15-$100	Operates with packets. Interactive, low speed data applications. Services fixed, portable, or mobile users. Transmits simultaneous messages from multiple transmitters at the same time to ensure reception. National paging services us satellites to relay messages between local systems.	Electronic Mail, Access to LAN's, WAN's, Point-of-sale and credit card verification, and Alarm monitoring.	Pagers - tone only or alphanumeric which can receive short text messages, e-mail, voice mail notification, and information services.
Packet Radio Networks	$25 to $300 per month depending on amount of data sent or the number of messages sent.	Two-way data Messaging using digital packets. Designed to deliver short text messages. Two companies dominate, Ardis and Ram Mobile Data. Service is not quite national, serving most metropolitan areas.	See Two-way Messaging.	Terrestrial towers operating in 800 MHZ SMR frequency band. Pagers, portable computers with radio modems, or portable fax machines.

Technology	Installation / User Fees	Capabilities	Applications	Required Equipment
Narrowband Personal Communications Service (PCS)	$200 per subscriber.	Low cost, 2 way data communication	Advanced paging and Messaging, Credit card verification, Locator services, and Voice and acknowledgment paging.	Terrestrial towers operating in 901-902, 930-931, or 940-941 MHZ SMR frequency band. Pagers, portable computers with radio modems, or portable fax machines.
Cellular Data (see Circuit switched cellular data and cellular digital packet data (CDPD) below)	$750 per subscriber.	Two-way data communications supporting voice, data, and images. Coverage area of the cellular tower is approximately a few miles (but up to 20 miles), but depends on the number of users. A channel used in one cell can be reused by another user in another cell if there is enough separation between the cells to minimize interference.	Connect to office LAN's, Send and receive E-mail or text files, Access on-line services, and Browse the Internet.	MTSO - Mobile Telephone Switching Office - connected by microwave or wired links to all of the base stations. Also connected to the public switched telephone network.
Circuit Switched Cellular Data		Preferred for large file transfers because price is based on 1 minute increments of air time.		Cellular towers and circuit switches. Computer with radio modem, Modem pool - allows radio modem users to dial into the pool at which point the carrier serves as a go between and translates data between two different modem types.
Personal Digital Assistants (PDA's)	$200 to $1,500 depending on added features.	Use cellular or private data networks.	E-mail, paging, faxing, and remote data access. Placing and receiving phone calls (added feature).	

Technology	Installation / User Fees	Capabilities	Applications	Required Equipment
PCMCIA cads (Personal Computer Memory Card International Association) .	$600 to 800 each.	Credit card size devices that plug into a special slot in the laptop computer and perform a range of functions. Modem, LAN access, hard drive, and GPS capabilities. PC cards can use cable to connect to radio waves.		
Cellular Digital Packet Data (CDPD)	$11 to $140 per month	Information broken into digital packets which can be sent over channels as they become vacant. Transmits data at speeds up to 19.2 Kbps. Favors shorter messages because cost is based on size of message rather than increments of air time.	Remotely connect to LAN's. Access databases, and exchange files, Credit card verification, Real estate transactions, Emergency services, Dispatch, Fleet management, Package delivery tracking, Two-way paging, Internet access, and Electronic mail.	Cellular towers and circuit switches. Computer with CDPD radio modem.
Wireless Local Area Networks (LAN's)	Wireless modems are up to $800. Access point equipment up to $2,500 each	Connects computers in a small area (i.e. office or school) and allows them to share information, send inter-building E-mail, or share printers. 1 to 2 Mbps on wireless versus 10 Mbps on wired LAN's. Wireless LAN's use infrared, narrowband, or un-licensed spread spectrum to operate.	A replacement for wired LAN's when buildings are hard to wire, when there is not enough room for wiring, or building contains asbestos.	Wireless modems. Access point equipment which allows multiple computers to connect to the LAN remotely.

Source: Office of Technology Assessment, 1995 and the Benton Foundation, 1997.

Wire-lined networks provide many of the same services and applications made available by wireless technologies. The current advantage of wired services is the speed of data transmission, the reliability of transferring and receiving information, and the cost of supporting equipment. However, as wireless technology matures, the services and products will prove to be cheaper and just as reliable as those based on wired networks. The appeal of wireless networks is mobility.

More often than not, telephones, faxes, computers, televisions, voice mail, E-mail, network connections use wire linked networks at some point in data communication. There are four "lines of communication", which include (Benton Foundation, 1997):

- POTS (plain old telephone lines) - transmits voice, data, and images.
- ISDN lines - twice the speed of POTS, also transmits voice, data, and images.
- T-1 lines - leased lines for point-to-point communication and transmits data 50-60 times the speed of POTS.
- T-3 lines - transmits dat and images 1,500 times the speed of traditional telephone lines.

Basically, wireless data communications require a receiving land based antenna (cellular towers or satellite dishes), switching stations which transmit the data horizontally between wireless towers (which then either transmit data over air waives to wireless receiving devices or through wired networks to wired devices), receiving equipment such as hand held devices (pagers, cellular phones, etc), lap top computers with built-in wireless modems, and adaptive communications infrastructure which translates data between wired and wireless sources.

The equipment located at the cellular or PCS base station includes the antenna, the radio transceivers, and the hardware/software components that link the site to other cell sites or switches in the system. The size and appearance of the base station infrastructure, although falling under the jurisdiction of local zoning authorities (unless it lies on federally owned land), varies due to the technological requirements of the system. Such requirements include: power output, frequency, topography, and foreseeable usage. A typical cellular base station stores the radio equipment in a storage facility 20' X 10' X 7', compared to the PCS system's storage container that is roughly the size of a refrigerator (Office of Technology Assessment, 1995).

7.2 Geography of Athol

The topography of Athol and its surrounding communities varies greatly. There are a number of high points shown on the USGS Topographic Map (see Appendix C) which conveniently lie along the major routes. These are marked by asterisks.

7.2.1 Opportunities

A database of the high points in Athol should be constructed, including information on ownership, the zoning district into which it falls, the dimensions of the parcels, etc. Other locational opportunities for wireless service providers include land owned by the federal government. The FCC mandates that all federal land be made available to wireless service providers, with no restrictions as to siting, height, and appearance. A list

of all federally owned land is provided in Appendix D. This listing should be compared to the town's parcel and topography maps to determine the lot's suitability for the siting of wireless infrastructure.

7.3 Incentives and Barriers to the Industry's Development

7.3.1 Zoning

The community is coming face-to-face with the telecommunications tower siting issue. Cellular One, which currently rents space on the tower located on Bear Den's Road, is seeking to erect an additional tower to improve its cellular service to Athol citizens. Applications for the siting of towers will be reviewed by the Design Review and Planning Board. Currently, Athol's Zoning Bylaws currently disallow towers of any kind. The town is amending the bylaws to include the term "Communication Towers with Transfer Stations" and is proposing that the use be allowed in each of its eight districts. However, there is no supporting text which regulates the physical design or siting of telecommunications infrastructure.

Speaking with local citizens, such as the town select person, a firefighter, employees of the Partnership Program, and a business owner, it seems as though they look forward to and welcome advancement in the telecommunications arena. This, however, does not mean that the siting of wireless facilities will go smoothly.

Cities, towns, and regional agencies have the option of being reactive or proactive to the siting of communications infrastructure. Siting regulations can be sensitive to the location and placement of communications infrastructure (Part I, Siting regulations).

7.3.2 Federal, State, and Local Incentives

> *"With its global scope, the industry is affected by agencies at the local, state, federal, and international levels."*

7.3.2.1 Federal Government

The Federal Communications Commission, which drafted the Telecommunications Act of 1996, serves as a facilitator in expanding the National and Global Information Infrastructure (NII/GII) by allocating radio band-widths, encouraging competition in all communications markets, mandating that all federal land be made available for communications infrastructure, and regulating the powers of local governments in the siting and design of communications infrastructure (Federal Communications Commission, 1997@ http://www.fcc.gov). The FCC's scope includes the development and implementation of policy concerning interstate and international communications by radio, television, wire, satellite, and cable.

Other agencies which operate at the national and international level include (Massachusetts Telecommunications Council, 1997 @ http://www.commx.org):

- National Telecommunications and Information Administration (NTIA)
- Information Infrastructure Task Force (IITF) - formed by the White House to articulate and implement the Administration's vision for the National Information Infrastructure (NII).
- American Electronics Association (AEA)
- International Communications Association (ICA)
- International Telecommunications Union (ITU) - headquartered in Geneva, Switzerland. An international organization within which governments and the private sector coordinate global telecommunications networks and services.

7.3.2.2 Massachusetts Government

At the state level, initiatives include assisting the 1,000 plus communication related companies (employing over 100,000 people) in the development of communications (Massachusetts Telecommunications Council, 1997). As such, the state has many agencies which carry out this and other initiatives. Below is a summary of key organizations and their purpose statements.

Table 7.3.2.2.1 MA Agencies that Promote and Support Communications Development

Agency	Purpose Statement
Mass Access to Government Network	
Mass Tech Collaborative	a public-private organization that works to foster a more favorable and responsive climate for the formation, retention, and expansion of technology-intensive enterprise in MA.
Massachusetts Office of Business Development (MOBD)	
Mass. Corporation for Educational Telecommunications (MCET)	provides telecommunications services through multiple technologies to students and educators in Massachusetts and 22 states nationwide.
Massachusetts Office of International Trade and Investment (MOITI)	provides a variety of services to Massachusetts' companies with international business interests.
Massachusetts Telecommunications Council (MTC)	monitors developments in this area and acts as a resource for the industry. mission: To promote Massachusetts as a world center for telecommunications by building on the extraordinarily high concentration of telecommunications organizations doing business in the state.

Agency	Purpose Statement
Critical Mass	works to ensure communication and collaboration among the architects and user communities of the Massachusetts information infrastructure. will act as an advisory committee for the various stakeholders of the Massachusetts information infrastructure in order to promote maximum standardization and inter-operability.
The Commonwealth Exchange	is a networking initiative of the Massachusetts Telecommunications Council, enabling regional organizations to establish collaborative efforts, share information, recruit personnel, and eventually conduct business over the Commonwealth Exchange network environment.
Massachusetts Access to Government Network (MAGNet)	a private Internet connecting agencies of the Commonwealth of Massachusetts. Shared services include electronic mail via a Wide Area Network with integrated Internet e-mail, a Web server, and network management services.
Massachusetts Education Computer Network (MECN)	reports to the Massachusetts Higher Education Coordinating Council (HECC). The mission of MECN is to provide efficient, reliable and cost-effective network services to support the missions of the public higher education institutions in Massachusetts.
Massachusetts Health Data Consortium, Inc.	The Massachusetts Health Data Consortium's mission is to improve health and health care in Massachusetts by improving the state's health care information infrastructure. Taking advantage of regional expertise in the information processing economy, the program aims to build on existing networks while encouraging collaboration and standardization among them.
Massachusetts Software Council	a non-profit trade association dedicated to promoting the software industry as well as helping Massachusetts software companies compete successfully in global markets.
Massachusetts Technology Collaborative	a public-private partnership created by state statute in 1982 to advance the interests of economic growth in the Commonwealth's technology sector.
University of Massachusetts	addresses the information and business needs of the users of the UMass system with its multi-platform, five-campus administrative computing environment, which uses the latest in inter- networking technologies.
Massachusetts Interactive Media Council (MIMC)	to promote our Commonwealth as a center for interactive media industry leadership and to provide a powerful economic engine for New England. Build the interactive media industry to realize its potential as a major economic force in Massachusetts; Facilitate communication and networking among companies and individuals in Massachusetts and worldwide; Provide local, national and international public and private education; Advocate for the Commonwealth's interactive media industry on state and federal levels; Work with other interactive media councils to leverage relationships, networking, advocacy and education; and Provide valuable information to members in the areas of technology, financing, legal issues and human resources.

Agency	Purpose Statement
Massachusetts Software Council	to promote the Massachusetts software industry and to help Massachusetts software companies at all stages of development compete successfully in global markets.
Massachusetts Education Computer Network (MECN)*	manages and operates MassNet, a statewide data communications network that connects 29 public higher education campuses. MassNet colleges and universities are also linked to the Internet through NEARnet. MECN reports to the Massachusetts Higher Education Coordinating Council.
Massachusetts Corporation for Educational Telecommunications (MCET)*	provides telecommunications services to Massachusetts students and educators. MCET is a quasi public agency that receives funding from both state and federal governments. School districts pay an initial $2,000 access fee plus a $1,000 membership fee for the first year to join MCET. The membership fee is $1,250 for the second year and $1,500 for the third. In addition to educational programs, MCET offers daily satellite broadcasts, E-mail and Internet links, videotape and videodisc programming, technical training, and content support advising. Its customer base has expanded to include nonprofit corporations, government agencies, and private businesses.
Massachusetts Executive Office of Education*	received a 1994 NTIA project grant for its proposal to construct the Massachusetts Information Infrastructure (MII). MII will coordinate the activities of the Office, MECN, MCET, and the Board of Library Commissions to develop a statewide, integrated, interactive voice and data network. Twenty sites have been connected under the terms of the grant out of a projected total of 352 throughout the state.
Mass Ed Online Project*	provide all public school students with timely computer learning tools. By 1998 Ed Online is expected to link all 40,000 public schools and about 100 universities and colleges. MCET is overseeing the project.

*Source: Massachusetts Telecommunications Council, 1997 @ http://www.commx.org and the Benton Foundation, 1997 @ http://www.benton.org/Library/State/statehome.html**

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7.3.3 Obstacles

There are currently two points of view concerning the development and investment in telecommunications infrastructure. Should Athol invest in infrastructure before there is demand, or should the town hold out until there is enough demand to justify the costs of infrastructure investment?

The first view postulates that there must first be a demand for telecommunications technology. Whereas in the past the industry was supplier driven (people were willing to accept whatever technological developments came there way), today the market is saturated with so many new developments and products that customers have the opportunity to pick and choose between which technologies they would find most useful. In effect, the industry is now customer-driven (Mayo, 1995). "Customers for goods, services, and information in every sphere of everyday life will want to be able to influence the form and makeup of some of the information they consume, while continuing to be passive recipients of other, prepackaged information products (NII 2000

Steering Committee , 1996)." What this spells out is that a wireless service provider will not develop infrastructure in a community in hopes that people will flock to use it, but that there must be a demand for the service prior to the provider's investment in a community.

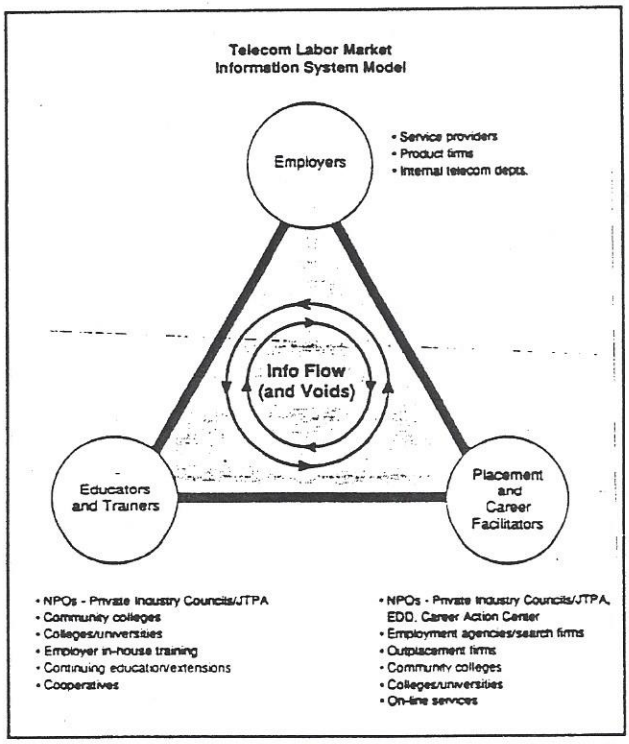
The second view regards investment in infrastructure as the first step towards promoting economic opportunities. Read and Youtie clarify the concept of the "supply-push" model of technology adoption. They state that, "...with deployment of new technology, a market for services based on this technology will eventually materialize. Advanced telecommunications infrastructure stimulates economic development..."

Systems Approach

A barrier that arises within the communications industry itself is, ironically, the dissemination of information. The Telecommunications Industry Report, produced by the Private Industry Council, clarifies this dilemma. The telecommunications labor market is viewed as a system. The key players are the employers, the educators, and the placement/career facilitators. The three comprise a "collection of parts which interact with each other to function as a whole" (Private Industry Council, 1996).

The following diagram depicts the optimal functioning of the System Approach (Source: Private Industry Council, 1996).

Figure 7.3.3.1 Systems Approach



The role played by each of the three contributors is not rigid. Employers act as educators and vice versa. There is a rift in communication amongst the three. Educational institutions find it difficult to keep up with the rapid change in technology and therefore produce potential workers with an outdated set of skills. Employers do not share their skill requirements to Educators and Placement/Career Facilitators, who have a great influence on the worker's preparedness. The report details how each of the three players could facilitate information sharing to their mutual advantage.

Should telecommunications and information technology be promoted as the up and coming industry in Athol, the Systems Approach concept will be crucial to its success. Athol can tap into the institutions of higher learning easily, both in Worcester and the Five College Network in Hampshire County. In addition, the skill requirements could be taught at the high school level. It is important that the residents of Athol learn these skills if they are to participate in the telecommunications labor market (assuming the development of the industry in Athol or the Montachusetts region).

8.0 Regional Connections and Support

8.1 State of Telecommunications Infrastructure in the Montachusetts Region

The installation of telecommunications infrastructure is not a piecemeal undertaking. Service providers develop a string of communication towers, town boundaries are irrelevant (except for the dealings with local zoning regulations and the community's reaction to the siting of facilities). Because the nature of the telecommunications industry is based on linkages, the communities within the Montachusetts region should unite and develop an agenda for the future state of telecommunications in the region. It is possible to minimize the number of towers per town (while taking into consideration the potential number of subscribers) by working towards a region wide network. Such a network would not only aid communication and information sharing within towns and between towns in the encompassing region, it could also link the region and its municipalities with subsequently larger geographical areas (i.e. other counties, cities, the state).

An assessment, not undertaken in this study, of the state of telecommunications infrastructure and the overall state of information technology usage in the Montachusetts region should be completed. It is only after one is aware of what resources are currently available that one can make decisions about what resources will be needed. Prior to this, the communities that reside within the Montachusetts region should open up lines of communication and discuss to what extent they wish to develop the telecommunications and information technology industries, and to what end. Massachusetts is already one of the top providers of these industries. Is there a reason why the Montachusetts region cannot tap into the industry's existing strength?

In order to gather the communities together and provide all with equal information, the municipalities should plan a charrette or a visioning meeting. The citizens, town officials, health and safety provider's, educators, industry representatives, and all other persons on whom technology will inevitably have an impact, should attend.

9.0 Recommendations

9.1 Athol at Present

At present, Athol does not have a developed communications network. The town has only one source of cellular service, provided by Cellular One. Coverage for this service does not extend far beyond Athol. AT & T does have an array of towers posted along Route 202, but this is only useful for persons passing by the town, not through it. The fire and police department use a radio broadcast dispatch service. The capacity of the system is not overburdened at the moment, but future capacity may need to be increased when the EMT service comes on line.

Based on a few conversations with people, which represent a range of interests (social worker, safety providers, town management, private business), the general attitude is one of frustration. The persons could be characterized as mid-30 to 40 somethings. Each would be eager to see the development of a communications network, be it by wired or wireless means. They want to feel "connected".

In order to get "connected" however, the town needs to move and act as a single voice in order to be heard by and attract the attention of telecommunications service providers.

9.2 Athol in the Future

The questions is whether telecommunication infrastructure can attract new firms and new jobs, and whether it can provide a strategic advantage in economic development. In 1988, the availability of telecommunications ranked 11 in a list of Site Selection Factors. In 1990 that rank moved down to 16, only to return to a rank of 12 in 1993 (Read and Youtie, 1996). In general, the availability of advanced telecommunications infrastructure is seen as desirable, but not necessary (Read and Youtie, 1996). One of the core reasons for stimulating investment in communications infrastructure is that the community can, at once, both market the community as a good investment option and ready the labor force in terms of necessary skills.

According to the report prepared by the organization, Kickstart Initiative, the following skills, will be necessary in the next decade (The Benton Foundation, 1997):

- ability to read, write, perform arithmetic and mathematical operations, listen, and speak;
- ability to think creatively, make decisions, solve problems, visualize, learn outside of the classroom environment, and reason;
- personal qualities, including responsibility, self-esteem, sociability, self-management, and integrity and honesty;
- ability to identify, organize, plan, and allocate resources;
- ability to work with others;
- ability to acquire and use information;
- ability to understand complex interrelationships among social, organizational, and technological systems; and
- the ability to work with a variety of technologies.

Many of these skills are an echo of those skills deemed necessary in the Bay Area Report discussed earlier.

Kickstart states that "Whether in the classroom, in a library, in a community center, or at home, every American who goes online is acquiring many of these skills -- often without ever knowing it."

Telecommunications has opened up rural communities to back office operations, which consist of "...data processing, inbound telemarketing (reservations, taking orders, customer service), and outbound telemarketing (telephone sales)" (Read and Youtie, 1996). Examples of successful back office operations include Citicorp's credit card processing center in Sioux Falls, South Dakota. Although back office firms create jobs that may not be lucrative, they do tend to offer more benefits that local jobs (see Table 2.1.3.1 in Part I for a summary of the benefits of telecommunications on rural areas).

There are so many benefits to be reaped by technology, both socially and economically. I am a proponent of information technology, but I also am cautious of the effects it can have on a society. I believe communities can, and will, balance the conflicts (such as the lessening of face-to-face or voice interaction made possible by e-mail or faxes).

It is no longer a choice of whether technology, particularly communications technology, is acceptable or unacceptable. The purpose of this research was to determine the impact of communications technology on rural areas and the option of wireless over wired networks, for "in the future, wireless systems and technologies will become an integral part of the overall communications infrastructure..." (Office of Technology Assessment, 1995). If a business is to thrive in today's society it must have, at the least, the rudiments of communications technology. The questions for each and every person, business, or organization are not just how far can they take it, but how far do they want to.

Appendix

AII. Demographic Tables

BII. Occupations and Skill Categories

CII. Topographic Map of Athol

DII. Federal Lands in Athol

EII. List of References

Appendix AII

Demographic Tables

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Table 6.1.20 & 6.1.21 Household Incomes for State, County, and Athol

Table 6.1.22 Age of householder by Household Income for State, County, and Athol

Table 6.1.23 Poverty Status by Sex and Age for State, County, and Athol (1990 US Census)

Table 6.1.1 Persons by Gender and Persons by Age

for Massachusetts, Worcester County, and Athol

Persons by Gender, 1990

PERSONS	Massachusetts	% Persons	Worcester Cty.	% Persons	Athol	% Persons
Male	2,886,477	48%	345,991	49%	5,539	48%
Female	3,129,948	52%	363,714	51%	5,912	52%
Total Persons:	**6,016,425**		**709,705**		**11,451**	

Source: US 1990 Census, Universe = Persons

Persons by Age, 1990

AGE	Massachusetts	% Persons	Worcester Cty.	% Persons	Athol	% Persons
Under 1 year	73,159	1%	9,355	1%	177	2%
1 and 2 years	173,718	3%	22,117	3%	438	4%
3 and 4 years	163,797	3%	21,537	3%	331	3%
5 years	79,985	1%	10,462	1%	213	2%
6 years	76,754	1%	9,962	1%	175	2%
7 to 9 years	221,782	4%	28,868	4%	555	5%
10 and 11 years	145,105	2%	18,040	3%	292	3%
12 and 13 years	135,911	2%	17,854	3%	393	3%
14 years	67,363	1%	8,249	1%	138	1%
15 years	69,079	1%	8,727	1%	109	1%
16 years	70,189	1%	8,835	1%	167	1%
17 years	74,543	1%	8,967	1%	137	1%
18 years	89,402	1%	10,363	1%	157	1%
19 years	105,376	2%	12,901	2%	139	1%
20 years	105,387	2%	12,816	2%	138	1%
21 years	101,711	2%	11,035	2%	92	1%
22 to 24 years	300,941	5%	31,729	4%	416	4%
25 to 29 years	555,805	9%	62,680	9%	1,005	9%
30 to 34 years	549,739	9%	65,312	9%	1,023	9%
35 to 39 years	481,717	8%	57,617	8%	755	7%
40 to 44 years	433,930	7%	49,703	7%	733	6%
45 to 49 years	341,242	6%	38,614	5%	604	5%
50 to 54 years	265,181	4%	29,477	4%	391	3%
55 to 59 years	253,448	4%	27,902	4%	517	5%
60 and 61 years	103,185	2%	11,174	2%	191	2%
62 to 64 years	158,049	3%	18,122	3%	270	2%
65 to 69 years	254,761	4%	28,822	4%	610	5%
70 to 74 years	209,370	3%	26,067	4%	392	3%
75 to 79 years	160,350	3%	19,353	3%	461	4%
80 to 84 years	105,655	2%	12,370	2%	260	2%
85 years and over	89,791	1%	10,675	2%	172	2%
Total Persons:	**6,016,425**	**100%**	**709,705**	**100%**	**11,451**	**100%**

Source: US 1990 Census, Universe = Persons

Table 6.1.2 Persons by Gender and Persons by Age
for Athol

Persons by Gender

PERSONS	1990	% of Persons	1980	% of Persons	1970	% of Persons	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Total	11,451	100.0%	10,576	100.0%	11,298	100.0%	8.3%	-6.4%	1.4%
Male	5,539	48.4%							
Female	5,912	51.6%							

Source: US Census, Universe = Persons

Persons by Age

AGE	1990	% of Persons	1980	% of Persons	1970	% of Persons	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Under 1 year	177	1.5%	108	1.0%			0.5%		
1 and 2 years	438	3.8%	314	3.0%			0.9%		
3 and 4 years	331	2.9%	306	2.9%			0.0%		
5 years	213	1.9%	129	1.2%			0.6%		
6 years	175	1.5%	140	1.3%			0.2%		
7 to 9 years	555	4.8%	532	5.0%			-0.2%		
10 and 11 years	292	2.5%		0.0%			2.5%		
12 and 13 years	393	3.4%	664	6.3%			-2.8%		
14 years	138	1.2%	161	1.5%			-0.3%		
15 years	109	1.0%	219	2.1%			-1.1%		
16 years	167	1.5%	169	1.6%			-0.1%		
17 years	137	1.2%	162	1.5%			-0.3%		
18 years	157	1.4%	196	1.9%			-0.5%		
19 years	139	1.2%	176	1.7%			-0.5%		
20 years	138	1.2%	144	1.4%			-0.2%		
21 years	92	0.8%	204	1.9%			-1.1%		
22 to 24 years	416	3.6%	450	4.3%			-0.6%		
25 to 29 years	1,005	8.8%	822	7.8%			1.0%		
30 to 34 years	1,023	8.9%	609	5.8%			3.2%		
35 to 39 years	755	6.6%		0.0%			6.6%		
40 to 44 years	733	6.4%	996	9.4%			-3.0%		
45 to 49 years	604	5.3%		0.0%			5.3%		
50 to 54 years	391	3.4%	1,033	9.8%			-6.4%		
55 to 59 years	517	4.5%	714	6.8%			-2.2%		
60 and 61 years	191	1.7%	191	1.8%			-0.1%		
62 to 64 years	270	2.4%	325	3.1%			-0.7%		
65 to 69 years	610	5.3%		0.0%			5.3%		
70 to 74 years	392	3.4%	993	9.4%			-6.0%		
75 to 79 years	461	4.0%		0.0%			4.0%		
80 to 84 years	260	2.3%	575	5.4%			-3.2%		
85 years and over	172	1.5%	244	2.3%			-0.8%		
Total all persons:	**11,451**	**100.0%**	**10,576**	**100.0%**					

Source: US Census, Universe = Persons

Table 6.1.3 Educational Attainment

for Massachusetts, Worcester County, and Athol

EDUCATIONAL ATTAINMENT	Massachusetts	% Persons 25 years and over	Worcester Cty.	% Persons 25 years and over	Athol	% Persons 25 years and over
Less than 9th grade	317,943	8%	40,533	9%	648	9%
9th to 12th grade, no diploma	474,714	12%	62,853	14%	1,191	16%
High school graduate (includes equivalency)	1,178,509	30%	140,441	31%	2,994	41%
Some college, no degree	624,944	16%	75,760	17%	1,158	16%
Associate degree	287,114	7%	36,434	8%	486	7%
Bachelor's degree	657,161	17%	64,459	14%	576	8%
Graduate or professional degree	421,838	11%	37,408	8%	331	4%
Total Persons 25 years and over:	**3,962,223**	**100%**	**457,888**	**100%**	**7,384**	**100%**

Source: US Census, Universe = Persons 25 years and over

EDUCATIONAL ATTAINMENT	Massachusetts	% Persons 18 years and over	Worcester Cty.	% Persons 18 years and over	Athol	% Persons 18 years and over
Less than 9th grade	332,380	7%	42,097	8%	648	8%
9th to 12th grade, no diploma	576,338	12%	75,103	14%	1,413	17%
High school graduate (includes equivalency)	1,390,157	30%	167,096	31%	3,492	42%
Some college, no degree	866,856	19%	102,942	19%	1,310	16%
Associate degree	325,207	7%	40,368	8%	529	6%
Bachelor's degree	746,818	16%	71,476	13%	603	7%
Graduate or professional degree	427,284	9%	37,650	7%	331	4%
Total Persons 18 years and over:	4,665,040	100%	536,732	100%	8,326	100%

Source: US Census, Universe = Persons 18 years and over

Table 6.1.4 Educational Attainment

for Athol

EDUCATIONAL ATTAINMENT	1990	% Persons 25 years and over	1980	% Persons 25 years and over	1970	% Persons 25 years and over	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Less than 9th grade	648	8.8%	1,288	19.8%	690	11.0%	-11.0%	8.8%	-2.2%
9th to 12th grade, no diploma	1,191	16.1%	1,282	19.7%	1,218	19.4%	-3.6%	0.3%	-3.3%
High school graduate (includes equivalency)	2,994	40.5%	2,751	42.3%	2,812	44.9%	-1.8%	-2.6%	-4.3%
Some college, no degree (1-3 years)	1,158	15.7%	807	12.4%	878	14.0%	3.3%	-1.6%	1.7%
Associate degree	486	6.6%							
Bachelor's degree	576	7.8%	4+ years		4+				
Graduate or professional degree	331	4.5%	374	5.8%	666	10.6%	-1.3%	-4.9%	-6.1%
Total persons 25 years and over:	**7,384**	**100.0%**	**6,502**	**100.0%**	**6,264**	**100.0%**		**3.8%**	

Source: US Census, Universe = Persons 25 years and over

EDUCATIONAL ATTAINMENT	1990	% Persons 18 years and over	1980	% Persons 18 years and over	1970	% Persons 18 years and over	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Less than 9th grade	648	7.8%	n/a		n/a				
9th to 12th grade, no diploma	1,413	17.0%	2,890	37.7%			-20.7%		
High school graduate (includes equivalency)	3,492	41.9%	3,329	43.4%			-1.5%		
Some college, no degree (1-3 years)	1,310	15.7%	1,040	13.6%			2.2%		
Associate degree	529	6.4%							
Bachelor's degree	603	7.2%	246	3.2%			4.0%		
Graduate or professional degree (5+ years)	331	4.0%	167	2.2%			1.8%		
Total persons 18 years and over:	**8,326**	**100.0%**	**7,672**	**100.0%**	**0**	**0.0%**	8.5%	**0.0%**	**0.0%**

Source: US Census, Universe = Persons 18 years and over

Table 6.1.5 Gender by Labor Force Status

for Massachusetts, Worcester County, and Athol

SEX BY EMPLOYMENT STATUS	Massachusetts	% Persons 16 years and over	% 16 years and over by gender category	Worcester Cty.	% Persons 16 years and over	% 16 years and over by gender category	Athol	% Persons 16 years and over	% 16 years and over by gender category
Male:									
In labor force:									
In Armed Forces	14,092	0.29%	0.62%	4,541	0.82%	1.71%	31	0.36%	0.77%
Civilian:									
Employed	1,585,698	32.97%	69.91%	183,853	33.15%	69.07%	2,672	30.96%	66.12%
Unemployed	129,269	2.69%	5.70%	15,308	2.76%	5.75%	311	3.60%	7.70%
Total males, not in labor force	**539,036**	**11.21%**	**23.77%**	**62,496**	**11.27%**	**23.48%**	**1,027**	**11.90%**	**25.41%**
Total males, in labor force:	**1,729,059**	**35.95%**	**76.23%**	**203,702**	**36.73%**	**76.52%**	**3,014**	**34.92%**	**74.59%**
Total males 16 years and over:	**2,268,095**	**47.16%**	**100.00%**	**266,198**	**48.00%**	**100.00%**	**4,041**	**46.83%**	**100.00%**
Female:									
In labor force:									
In Armed Forces	1,821	0.04%	0.07%	616	0.11%	0.21%	13	0.15%	0.28%
Civilian:									
Employed	1,442,252	29.99%	56.74%	159,186	28.71%	55.21%	2,129	24.67%	46.39%
Unemployed	88,731	1.84%	3.49%	10,230	1.84%	3.55%	274	3.17%	5.97%
Total females, not in labor force	**1,008,873**	**20.98%**	**39.69%**	**118,304**	**21.33%**	**41.03%**	**2,173**	**25.18%**	**47.35%**
Total females, in labor force:	**1,532,804**	**31.87%**	**60.31%**	**170,032**	**30.66%**	**58.97%**	**2,416**	**28.00%**	**52.65%**
Total females 16 years and over:	**2,541,677**	**52.84%**	**100.00%**	**288,336**	**52.00%**	**100.00%**	**4,589**	**53.17%**	**100.00%**
Total persons not in labor force	**1,547,909**	**32.18%**		**180,800**	**32.60%**		**3,200**	**37.08%**	
Total persons in labor force:	**3,261,863**	**67.82%**		**373,734**	**67.40%**		**5,430**	**62.92%**	
Total persons 16 years and over:	**4,809,772**	**100.00%**		**554,534**	**100.00%**		**8,630**	**100.00%**	

Source: US 1990 Census, Universe = Persons 16 years and over

Table 6.1.6 Gender by Labor Force Status

for Athol

SEX BY EMPLOYMENT STATUS	1990	% persons 16 years and over	% 16 years and	1980	% persons 16	% 16 years and over by gender category	1970	% persons 16 years and over	% 16 years and over by gender	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Male:										% Change by Gender Category		
In labor force:												
In Armed Forces	31	0%	1%		0%	0%		0%	0%			
Civilian:												
Employed	2,672	31%	66%	2,515	31%	67%	2,630	33%	71%			
Unemployed	311	4%	8%	183	2%	5%	107	1%	3%			
Total males not in labor force	**1,027**	**12%**	**25%**	**1,031**	**13%**	**28%**	**973**	**12%**	**26%**	**-2%**	**1%**	**-1%**
Total males in labor force:	**3,014**	**35%**	**75%**	**2,698**	**34%**	**72%**	**2,737**	**34%**	**74%**	**2%**	**-1%**	**1%**
Total males 16 years and over:	**4,041**	**47%**	**100%**	**3,729**	**47%**	**100%**	**3,710**	**47%**	**100%**	**0%**	**0%**	**0%**
Female:										% Change by Gender Category		
In labor force:												
In Armed Forces	13	0%	0%		0%	0%		0%	0%			
Civilian:												
Employed	2,129	25%	46%	1,972	25%	46%	1,728	22%	41%			
Unemployed	274	3%	6%	107	1%	3%	92	1%	2%			
Total females not in labor force	**2,173**	**25%**	**47%**	**2,195**	**27%**	**51%**	**2,428**	**31%**	**57%**	**-4%**	**-6%**	**-10%**
Total females in labor force:	**2,416**	**28%**	**53%**	**2,079**	**26%**	**49%**	**1,820**	**23%**	**43%**	**4%**	**6%**	**10%**
Total females 16 years and over:	**4,589**	**53%**	**100%**	**4,274**	**53%**	**100%**	**4,248**	**53%**	**100%**	**0%**	**0%**	**0%**
Total Persons 16 years and over:	8,630	100%		8,003	100%		7,958	100%				
In labor force	5,430	63%		4,777	60%		4,557	57%		**3%**	**2%**	**6%**
Not in labor force	3,200	37%		3,226	40%		3,401	43%		**-3%**	**-2%**	**-6%**

Universe: Persons 16 years and over

Table 6.1.7 Females 16 Years and over by Presence and Age of Children and Labor Force Status

for Massachusetts, Worcester County, and Athol

PRESENCE AND AGE OF CHILDREN AND EMPLOYMENT STATUS	Massachusetts	% Females 16 years and over	Worcester Cty.	% Females 16 years and over	Athol	% Females 16 years and over
With own children under 18 years:						
Under 6 years only:						
In labor force:	**126,027**	**4.96%**	**15,654**	**5.43%**	**239**	**5.21%**
Employed or in Armed Forces	115,378	4.54%	14,359	4.98%	197	4.29%
Unemployed	10,649	0.42%	1,295	0.45%	42	0.92%
Not in labor force	**80,362**	**3.16%**	**10,349**	**3.59%**	**224**	**4.88%**
6 to 17 years only:						
In labor force:	**278,078**	**10.94%**	**35,697**	**12.38%**	**555**	**12.09%**
Employed or in Armed Forces	262,414	10.32%	33,668	11.68%	518	11.29%
Unemployed	15,664	0.62%	2,029	0.70%	37	0.81%
Not in labor force	**79,914**	**3.14%**	**9,404**	**3.26%**	**196**	**4.27%**
Under 6 years and 6 to 17 years:						
In labor force:	**79,897**	**3.14%**	**10,313**	**3.58%**	**200**	**4.36%**
Employed or in Armed Forces	73,772	2.90%	9,571	3.32%	169	3.68%
Unemployed	6,125	0.24%	742	0.26%	31	0.68%
Not in labor force	**59,517**	**2.34%**	**7,677**	**2.66%**	**165**	**3.60%**
No own children under 18 years:						
In labor force:	**1,048,802**	**41.26%**	**108,368**	**37.58%**	**1,422**	**30.99%**
Employed or in Armed Forces	992,509	39.05%	102,204	35.45%	1,258	27.41%
Unemployed	56,293	2.21%	6,164	2.14%	164	3.57%
Not in labor force	**789,080**	**31.05%**	**90,874**	**31.52%**	**1,588**	**34.60%**
Total females with own children under 18 years:	2,541,677	100.00%	288,336	100.00%	4,589	100.00%
In labor force	1,532,804	60.31%	170,032	58.97%	2,416	52.65%
Not in labor force	1,008,873	39.69%	118,304	41.03%	2,173	47.35%

Source: US 1990 Census, Universe = Females 16 years and over

Table 6.1.8 Females 16 years and over by Presence and Age of Children and Labor Force Status

for Athol

PRESENCE AND AGE OF CHILDREN AND EMPLOYMENT STATUS	1990	% females 16 years and over	1980	% females 16 years and over	1970	% females 16 years and over	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
With children under 6 years only:									
In labor force:	239	5%	276	6%	127	3%	-1%	3%	2%
Employed or in Armed Forces	197	4%							
Unemployed	42	1%							
Not in labor force	224	5%	328	7%	464	10%	-2%	-3%	-5%
With children 6 to 17 years only:									
In labor force:	555	12%	515	11%	412	9%	1%	2%	3%
Employed or in Armed Forces	518	11%							
Unemployed	37	1%							
Not in labor force	196	4%	218	5%	297	6%	0%	-2%	-2%
Total females with own children under 18 years:	2,008	44%	1,337	29%	1,300	28%	15%	1%	15%
In labor force	794	17%	791	17%	539	12%	0%	5%	6%
Not in labor force	420	9%	546	12%	761	17%	-3%	-5%	-7%

Source: US Census, Universe = females 16 years and over

Table 6.1.9 Gender by Work Status

for Massachusetts, Worcester County, and Athol

SEX BY WORK STATUS IN 1989	Massachusetts	% Persons 16 years and over	Worcester Cty.	% Persons 16 years and over	Athol	% Persons 16 years and over
Universe: Persons 16 years and over						
Male:						
Worked in 1989	1,840,377	38.26%	216,677	39.07%	3,181	36.86%
Did not work in 1989	427,718	8.89%	49,521	8.93%	860	9.97%
Female:						
Worked in 1989	1,672,948	34.78%	186,937	33.71%	2,581	29.91%
Did not work in 1989	868,729	18.06%	101,399	18.29%	2,008	23.27%
Total Persons 16 years and over:	**4,809,772**	**100.00%**	**554,534**	**100.00%**	**8,630**	**100.00%**

Source: US 1990 Census, Universe = Persons 16 years and over

Table 6.1.10 Gender by Work Status

for Athol

SEX BY WORK STATUS IN 1989	1990	% persons 16 years and over	1980	% persons 16 years and over	1970	% persons 16 years and over	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Male:									
Worked in 1989	3,181	37%							
Did not work in 1989	860	10%							
Female:									
Worked in 1989	2,581	30%							
Did not work in 1989	2,008	23%							
Total persons 16 years and over:	**8,630**	**100%**							

Source: US Census, Universe = Persons 16 years and over

Table 6.1.11 Transportation and Commuting Patterns

for Massachusetts, Worcester County, and Athol

	Massachusetts	% Workers 16 years and over	Worcester Cty.	% Workers 16 years and over	Athol	% Workers 16 years and over
PLACE OF WORK--STATE & COUNTY LEVEL						
Worked in State of residence:	2,886,054	97%	333,341	98%	4,681	98%
Worked in county of residence	*2,063,962*	*69%*	*266,254*	*78%*	*3,765*	*79%*
Worked outside county of residence	*822,092*	*28%*	*67,087*	*20%*	*916*	*19%*
Worked outside State of residence	93,540	3%	7,502	2%	89	2%
Not Reported						
Total Workers 16 years and over:	**2,979,594**	**100%**	**340,843**	**100%**	**4,770**	**100%**
PLACE OF WORK--PLACE LEVEL						
Living in a place:	2,116,431	71%	186,072	55%	3,589	75%
Worked in place of residence	*846,404*	*28%*	*93,388*	*27%*	*1,931*	*40%*
Worked outside place of residence	*1,270,027*	*43%*	*92,684*	*27%*	*1,658*	*35%*
Not living in a place	863,163	29%	154,771	45%	1,181	25%
Not Reported		0%		0%		0%
Total Workers 16 years and over:	**2,979,594**	**100%**	**340,843**	**100%**	**4,770**	**100%**
MEANS OF TRANSPORTATION TO WORK						
Car, truck, or van:	2,466,091	83%	308,297	90%	4,283	90%
Drove alone	*2,148,065*	*72%*	*268,651*	*79%*	*3,510*	*74%*
Carpooled	*318,026*	*11%*	*39,646*	*12%*	*773*	*16%*
Public transportation:	247,381	8%	6,087	2%	15	0%
Bus or trolley bus	*103,010*	*3%*	*4,832*	*1%*	*7*	*0%*
Streetcar or trolley car	*17,334*	*1%*	*51*	*0%*	*0*	*0%*
Subway or elevated	*90,455*	*3%*	*49*	*0%*	*0*	*0%*
Railroad	*28,469*	*1%*	*512*	*0%*	*8*	*0%*
Ferryboat	*1,918*	*0%*	*0*	*0%*	*0*	*0%*
Taxicab	*6,195*	*0%*	*643*	*0%*	*0*	*0%*
Motorcycle	2,149	0%	262	0%	7	0%
Bicycle	11,285	0%	545	0%	23	0%
Walked	161,820	5%	15,733	5%	323	7%
Other means	16,013	1%	1,949	1%	34	1%
Worked at home	74,855	3%	7,970	2%	85	2%
Total Workers 16 years and over:	**2,979,594**	**100%**	**340,843**	**100%**	**4,770**	**100%**
TRAVEL TIME TO WORK						
Did not work at home:	*2,904,739*	*97%*	*332,873*	*98%*	*4,685*	*98%*
Less than 5 minutes	102,183	3%	14,638	4%	366	8%
5 to 9 minutes	361,194	12%	49,242	14%	1,169	25%
10 to 14 minutes	469,108	16%	56,993	17%	985	21%
15 to 19 minutes	463,341	16%	53,499	16%	460	10%
20 to 24 minutes	399,238	13%	44,320	13%	367	8%
25 to 29 minutes	158,549	5%	18,734	5%	170	4%
30 to 34 minutes	381,108	13%	36,503	11%	263	6%
35 to 39 minutes	81,012	3%	8,562	3%	83	2%
40 to 44 minutes	101,984	3%	9,697	3%	137	3%
45 to 59 minutes	216,450	7%	21,991	6%	419	9%
60 to 89 minutes	140,621	5%	14,989	4%	224	5%
90 or more minutes	29,951	1%	3,705	1%	42	1%
Worked at home	*74,855*	*3%*	*7,970*	*2%*	*85*	*2%*
Mean travel time to work (worker16 years and over who did not work at home):	22.74		21.53		19.29	
Total Workers 16 years and over:	**2,979,594**	**100%**	**340,843**	**100%**	**4,770**	**100%**
PRIVATE VEHICLE OCCUPANCY						
Car, truck, or van:						
Drove alone	2,148,065	72%	268,651	79%	3,510	74%
In 2-person carpool	263,394	9%	33,246	10%	696	15%
In 3-person carpool	32,591	1%	4,074	1%	59	1%
In 4-person carpool	9,900	0%	1,113	0%	12	0%
In 5-person carpool	3,611	0%	364	0%	0	0%
In 6-person carpool	2,019	0%	151	0%	0	0%
In 7-or-more person carpool	6,511	0%	698	0%	6	0%
Other means	513,503	17%	32,546	10%	487	10%
Total Workers 16 years and over:	**2,979,594**	**100%**	**340,843**	**100%**	**4,770**	**100%**

Source: US 1990 Census, Universe = Workers 16 years and over

Table 6.1.12 Transportation and Commuting Patterns

for Athol

	1990	% Workers 16 years and over	1980	% Workers 16 years and over	% Change 1980-1990
PLACE OF WORK – STATE AND COUNTY LEVEL					
Worked in State of residence:					
Worked in county of residence	3,765	78.9%	3,737	85.7%	-6.8%
Worked outside county of residence	916	19.2%	384	8.8%	10.4%
Worked outside State of residence	89	1.9%	25	0.6%	1.3%
Not Reported			214		
Total workers 16 years and over:	**4,770**		**4,360**		
PLACE OF WORK – PLACE LEVEL					
Living in a place:					
Worked in place of residence	1,931	40.5%	81	1.9%	38.6%
Worked outside place of residence	1,658	34.8%	3,387	77.7%	-42.9%
Not living in a place	1,181	24.8%	753	17.3%	7.5%
Not Reported			139	3.2%	
Total workers 16 years and over:	**4,770**		**4,360**		
MEANS OF TRANSPORTATION TO WORK					
Car, truck, or van:	4,283	89.8%	3,407	78.1%	11.6%
Drove alone	3,510	73.6%	2,400	55.0%	18.5%
Carpooled	773	16.2%	1,007	23.1%	-6.9%
Public transportation:	15	0.3%	13	0.3%	0.0%
Bus or trolley bus	7	0.1%			
Streetcar or trolley car	0	0.0%			
Subway or elevated	0	0.0%			
Railroad	8	0.2%			
Ferryboat	0	0.0%			
Taxicab	0	0.0%			
Motorcycle	7	0.1%			
Bicycle	23	0.5%			
Walked	323	6.8%	736	16.9%	-10.1%
Other means	34	0.7%	55	1.3%	-0.5%
Worked at home	85	1.8%	104	2.4%	-0.6%
Total workers 16 years and over:	**4,770**		**4,315**		
TRAVEL TIME TO WORK					
Did not work at home:	4,685	98.2%	4,248	97.4%	0.8%
Less than 5 minutes	366	7.7%	250	5.7%	1.9%
5 to 9 minutes	1,169	24.5%	1,526	35.0%	-10.5%
10 to 14 minutes	985	20.6%	1,174	26.9%	-6.3%
15 to 19 minutes	460	9.6%	501	11.5%	-1.8%
20 to 24 minutes	367	7.7%			
25 to 29 minutes	170	3.6%	393	9.0%	-5.4%
30 to 34 minutes	263	5.5%			
35 to 39 minutes	83	1.7%			
40 to 44 minutes	137	2.9%	231	5.3%	-2.4%
45 to 59 minutes	419	8.8%	103	2.4%	6.4%
60 to 89 minutes	224	4.7%			
90 or more minutes	42	0.9%	70	1.6%	-0.7%
Worked at home	85	1.8%			
Mean travel time to work (workers 16 years and over who did not work at home):	*19*		*13*		
Total workers 16 years and over:	**4,770**		**4,248**		
PRIVATE VEHICLE OCCUPANCY					
Car, truck, or van:					
Drove alone.	3,510	73.6%	2,400	55.0%	18.5%
In 2-person carpool	696	14.6%	831	19.1%	-4.5%
In 3-person carpool	59	1.2%	106	2.4%	-1.2%
In 4-person carpool	12	0.3%	30	0.7%	-0.4%
In 5-person carpool	0	0.0%			
In 6-person carpool	0	0.0%			
In 7-or-more person carpool	6	0.1%	40	0.9%	-0.8%
Other means	487	10.2%	n/a		
Total workers 16 years and over:	**4,770**		**3,407**		

Source: US Census, Universe = Workers 16 years and over

note: 1980 totals for each category should equal 4,360 workers 16 years and over. This figure was used as the base for 1980 percentages.

Table 6.1.13 Employed Persons 16 years and over by Industry

for Massachusetts, Worcester County, and Athol

INDUSTRY	Massachusetts	% Employed persons 16 years and over	Worcester Cty.	% Employed persons 16 years and over	Athol	% Employed persons 16 years and over
Agriculture, forestry, and fisheries (000-039)	129,908	4.2%	3,711	1.0%	64	1.3%
Mining (040-059)	2,682	0.1%	12,086	3.4%	0	0.0%
Construction (060-099)	165,540	5.3%	18,398	5.2%	252	5.2%
Manufacturing, nondurable goods (100-229)	184,352	5.9%	23,988	6.8%	421	8.8%
Manufacturing, durable goods (230-399)	363,572	11.6%	58,409	16.5%	1,188	24.7%
Transportation (400-439)	113,400	3.6%	11,953	3.4%	128	2.7%
Communications and other public utilities (440-499)	73,891	2.4%	7,816	2.2%	94	2.0%
Wholesale trade (500-579)	125,574	4.0%	18,227	5.1%	177	3.7%
Retail trade (580-699)	490,032	15.7%	54,280	15.3%	729	15.2%
Finance, insurance, and real estate (700-720)	242,828	7.8%	22,539	6.4%	187	3.9%
Business and repair services (721-760)	141,679	4.5%	13,902	3.9%	128	2.7%
Personal services (761-799)	78,794	2.5%	7,284	2.1%		0.0%
Entertainment and recreation services (800-811)	34,200	1.1%	2,928	0.8%	123	2.6%
Professional and related services (812-899):						
Health services (812-840)	311,431	10.0%	36,335	10.2%	502	10.5%
Educational services (842-860)	287,795	9.2%	30,011	8.5%	359	7.5%
Other professional and related services (841, 861-899)	249,696	8.0%	20,883	5.9%	258	5.4%
Public administration (900-939)	129,908	4.2%	12,086	3.4%	191	4.0%
Total employed persons 16 years and over:	**3,125,282**	**100.0%**	**354,836**	**100.0%**	**4,801**	**100.0%**

Source: US 1990 Census, Universe = Employed persons 16 years and over

Table 6.1.14 Employed Persons 16 years and over by Industry, Athol

for Athol

INDUSTRY	1990	% Employed persons	1980	% Employed persons	1970	% Employed persons	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Agriculture, forestry, fisheries, and mining (000-059)	64	1%	46	1%	37	1%	0%	0%	0%
Construction (060-099)	252	5%	123	3%	165	4%	3%	-1%	1%
Manufacturing, nondurable goods (100-229)	421	9%	411	9%	412	9%	0%	0%	-1%
Manufacturing, durable goods (230-399)	1,188	25%	2,117	47%	1,869	43%	-22%	4%	-18%
Transportation (400-439)	128	3%	103	2%	55	1%	0%	1%	1%
Communications and other public utilities (440-499)	94	2%	53	1%	76	2%	1%	-1%	0%
Wholesale trade (500-579)	177	4%	52	1%	104	2%	3%	-1%	1%
Retail trade (580-699)	729	15%	499	11%	648	15%	4%	-4%	0%
Finance, insurance, and real estate (700-720)	187	4%	135	3%	133	3%	1%	0%	1%
Business and repair services (721-760)	128	3%	81	2%	55	1%	1%	1%	1%
Personal services, Entertainment and Recreation services (761-811)	123	3%	145	3%	128	3%	-1%	0%	0%
Professional and related services (812-899):									
Health services (812-840)	502	10%	258	6%	222	5%	5%	1%	5%
Educational services (842-860)	359	7%	249	6%	272	6%	2%	-1%	1%
Other professional and related services (841, 861-899)	258	5%	106	2%	67	2%	3%	1%	4%
Public administration (900-939)	191	4%	109	2%	115	3%	2%	0%	1%
Total employed persons 16 years and over:	**4,801**	**100%**	**4,487**	**100%**	**4,358**	**100%**			

Source: US Census, Universe = Employed persons 16 years and over

Table 6.1.15 Industry Location Quotients

INDUSTRY	EMPLOYED PERSONS 16 YRS. AND OVER			LOCATION QUOTIENTS	
	Massachusetts	Worcester Cty.	Athol	Athol:Worcester Cty.	Athol:MA
Agriculture, forestry, and fisheries	32,576	3,711	64	1.23	1.24
Mining	2,682	289	0	**0.00**	**0.00**
Construction	165,540	18,398	252	0.98	0.96
Manufacturing, nondurable goods	184,352	23,988	421	**1.25**	**1.44**
Manufacturing, durable goods	363,572	58,409	1,188	**1.45**	**2.06**
Transportation	113,400	11,953	128	0.77	**0.71**
Communications and other public utilities	73,891	7,816	94	0.86	0.80
Wholesale trade	125,574	18,227	177	**0.69**	0.89
Retail trade	490,032	54,280	729	0.96	0.94
Finance, insurance, and real estate	242,828	22,539	187	**0.59**	**0.49**
Business and repair services	141,679	13,902	128	**0.66**	**0.57**
Personal services	78,794	7,284	106	1.04	0.85
Entertainment and recreation services	34,200	2,928	17	**0.41**	**0.31**
Professional and related services:					
Health services	311,431	36,335	502	0.99	1.02
Educational services	287,795	30,011	359	0.85	0.79
Other professional and related services	249,696	20,883	258	0.88	**0.65**
Public administration	129,908	12,086	191	1.13	0.93
Total Employed persons 16 years and over	**3,027,950**	**343,039**	**4,801**		

Source: US 1990 Census, Universe = Employed persons 16 years and over

Table 6.1.16 Employed Persons 16 years and over by Occupation

for Massachusetts, Worcester County, and Athol

OCCUPATION	Massachusetts	% Employed persons 16 years and over	Worcester Cty.	% Employed persons 16 years and over	Athol	% Employed persons 16 years and over
Managerial and professional specialty occupations (000-202):						
Executive, administrative, and managerial occupations (000-042)	442,912	14.6%	45,553	13.3%	422	8.8%
Professional specialty occupations (043-202)	527,071	17.4%	54,648	15.9%	454	9.5%
Technical, sales, and administrative support occupations (203-402):						
Technicians and related support occupations (203-242)	127,084	4.2%	14,274	4.2%	127	2.6%
Sales occupations (243-302)	344,100	11.4%	36,897	10.8%	495	10.3%
Administrative support occupations, including clerical (303-402)	523,096	17.3%	58,083	16.9%	789	16.4%
Service occupations (403-472):						
Private household occupations (403-412)	7,854	0.3%	658	0.2%	0	0.0%
Protective service occupations (413-432)	59,274	2.0%	6,194	1.8%	108	2.2%
Service occupations, except protective and household (433-472)	321,147	10.6%	36,733	10.7%	614	12.8%
Farming, forestry, and fishing occupations (473-502)	28,098	0.9%	3,262	1.0%	68	1.4%
Precision production, craft, and repair occupations (503-702)	301,981	10.0%	38,264	11.2%	676	14.1%
Operators, fabricators, and laborers (703-902):						
Machine operators, assemblers, and inspectors (703-802)	168,169	5.6%	25,394	7.4%	694	14.5%
Transportation and material moving occupations (803-863)	87,588	2.9%	11,639	3.4%	193	4.0%
Handlers, equipment cleaners, helpers, and laborers (864-902)	89,576	3.0%	11,440	3.3%	161	3.4%
Total employed persons 16 years and over:	**3,027,950**	**100.0%**	**343,039**	**100.0%**	**4,801**	**100.0%**

Source: US 1990 Census, Universe = Employed persons 16 years and over

Table 6.1.17 Employed Persons 16 years and over by Occupation, Athol

for Athol

OCCUPATION	1990	% Employed persons	1980	% Employed persons	1970	% Employed persons	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Managerial and professional specialty occupations (000-202):									
Executive, administrative, and managerial occupations (000-042)	422	9%	272	6%			3%		
Professional specialty occupations (043-202)	454	9%	328	7%			2%		
Technical, sales, and administrative support occupations (203-402):									
Technicians and related support occupations (203-242)	127	3%	87	2%			1%		
Sales occupations (243-302)	495	10%	262	6%			4%		
Administrative support occupations, including clerical (303-402)	789	16%	756	17%			0%		
Service occupations (403-472):									
Private household occupations (403-412)	0		22	0%			0%		
Protective service occupations (413-432)	108	2%	50	1%			1%		
Service occupations, except protective and household (433-472)	614	13%	385	9%			4%		
Farming, forestry, and fishing occupations (473-502)	68	1%	48	1%			0%		
Precision production, craft, and repair occupations (503-702)	676	14%	688	15%			-1%		
Operators, fabricators, and laborers (703-902):									
Machine operators, assemblers, and inspectors (703-802)	694	14%	1,223	27%			-13%		
Transportation and material moving occupations (803-863)	193	4%	153	3%			1%		
Handlers, equipment cleaners, helpers, and laborers (864-902)	161	3%	213	5%			-1%		
Total employed persons 16 years and over:	**4,801**	**100%**	**4,487**	**100%**					

Source: US Census, Universe = Employed persons 16 years and over

Table 6.1.18 Employed Persons 16 years and over by Class of Worker

for Massachusetts, Worcester County, and Athol

CLASS OF WORKER	Massachusetts	% Employed persons 16 years and over	Worcester Cty.	% Employed persons 16 years and over	Athol	% Employed persons 16 years and over
Private for profit wage and salary workers	2,130,858	70.4%	251,591	73.3%	3,530	73.5%
Private not-for-profit wage and salary workers	294,142	9.7%	25,310	7.4%	308	6.4%
Local government workers	214,783	7.1%	24,894	7.3%	387	8.1%
State government workers	122,307	4.0%	15,041	4.4%	197	4.1%
Federal government workers	78,225	2.6%	6,803	2.0%	69	1.4%
Self-employed workers	180,228	6.0%	18,466	5.4%	301	6.3%
Unpaid family workers	7,407	0.2%	934	0.3%	9	0.2%
Total employed persons 16 years and over:	**3,027,950**	**100.0%**	**343,039**	**100.0%**	**4,801**	**100.0%**

Source: US 1990 Census, Universe = Employed persons 16 years and over

Table 6.1.19 Employed Persons 19 years and over by Class of Worker, Athol

for Athol

CLASS OF WORKER	1990	% Employed persons	1980	% Employed persons	1970	% Employed persons	% Change 1980-1990	% Change 1970-1980	% Change 1970-1990
Private for profit wage and salary workers	3,530	74%	3,777	84%	3,667	79%	-11%	5%	-5%
Private not-for-profit wage and salary workers	308	6%					n/a		
Local government workers	387	8%	286	6%	291	6%	2%	0%	2%
State government workers	197	4%	133	3%	Fed+State		1%		
Federal government workers	69	1%	12	0%	414	9%	1%	-9%	-7%
Self-employed workers	301	6%	250	6%	265	6%	1%	0%	1%
Unpaid family workers	9	0%	29	1%	12	0%	0%	0%	0%
Total employed persons 16 years and over:	**4,801**	**100%**	**4,487**	**100%**	**4,649**	**100%**			

Source: US Census, Universe = Employed persons 16 years and over

Table 6.1.20 Household Incomes

for Massachusetts, Worcester County, and Athol

HOUSEHOLD INCOME IN 1989 (total households)	Massachusetts	% of Households	Worcester Cty.	% of Households	Athol	% of Households
Less than $5,000	91,295	4%	9,457	4%	183	4%
$5,000 to $9,999	209,406	9%	25,749	10%	533	12%
$10,000 to $12,499	79,429	4%	9,447	4%	286	7%
$12,500 to $14,999	66,929	3%	8,184	3%	172	4%
$15,000 to $17,499	76,818	3%	9,291	4%	213	5%
$17,500 to $19,999	70,648	3%	8,597	3%	189	4%
$20,000 to $22,499	83,863	4%	9,890	4%	225	5%
$22,500 to $24,999	68,475	3%	8,936	3%	225	5%
$25,000 to $27,499	85,480	4%	10,273	4%	179	4%
$27,500 to $29,999	68,408	3%	8,323	3%	101	2%
$30,000 to $32,499	89,784	4%	10,643	4%	180	4%
$32,500 to $34,999	67,061	3%	7,958	3%	212	5%
$35,000 to $37,499	82,740	4%	10,434	4%	163	4%
$37,500 to $39,999.	66,641	3%	8,344	3%	173	4%
$40,000 to $42,499	82,380	4%	10,544	4%	165	4%
$42,500 to $44,999	61,175	3%	7,372	3%	125	3%
$45,000 to $47,499	69,006	3%	8,753	3%	170	4%
$47,500 to $49,999	55,108	2%	6,980	3%	92	2%
$50,000 to $54,999	119,618	5%	14,417	6%	155	4%
$55,000 to $59,999	97,719	4%	11,865	5%	150	3%
$60,000 to $74,999	224,308	10%	25,223	10%	264	6%
$75,000 to $99,999	178,806	8%	17,528	7%	108	2%
$100,000 to $124,999	72,509	3%	5,998	2%	39	1%
$125,000 to $149,999	29,839	1%	2,484	1%	30	1%
$150,000 or more	46,961	2%	3,268	1%	20	0%
Total Households:	**2,244,406**	**100%**	**259,958**	**100%**	**4,352**	**100%**
Median Household Income	**36,952**		**35,774**		**27,095**	
Per capita income in 1989	**17,224**		**15,500**		**1,244**	

Source: US 1990 Census, Universe = Households

Table 6.1.21 Household Incomes
for Athol

HOUSEHOLD INCOME IN 1989 (total households)	1990	% of Households	1980	% of Households	% Change 1980-1990
Less than $5,000	183	4.2%	528	13.8%	-9.6%
$5,000 to $9,999	533	12.2%	892	23.4%	-11.1%
$10,000 to $12,499	286	6.6%	201	5.3%	1.3%
$12,500 to $14,999	172	4.0%	289	7.6%	-3.6%
$15,000 to $17,499	213	4.9%	307	8.0%	-3.1%
$17,500 to $19,999	189	4.3%	261	6.8%	-2.5%
$20,000 to $22,499	225	5.2%	249	6.5%	-1.3%
$22,500 to $24,999	225	5.2%	254	6.6%	-1.5%
$25,000 to $27,499	179	4.1%	191	5.0%	-0.9%
$27,500 to $29,999	101	2.3%	147	3.8%	-1.5%
$30,000 to $32,499					
$32,500 to $34,999	392	9.0%	198	5.2%	3.8%
$35,000 to $37,499					
$37,500 to $39,999.	336	7.7%	110	2.9%	4.8%
$40,000 to $42,499					
$42,500 to $44,999					
$45,000 to $47,499					
$47,500 to $49,999	552	12.7%	129	3.4%	9.3%
$50,000 to $54,999					
$55,000 to $59,999					
$60,000 to $74,999	569	13.1%	50	1.3%	11.8%
$75,000 to $99,999					
$100,000 to $124,999					
$125,000 to $149,999	>$75K		>$75K		
$150,000 or more	197	4.5%	14	0.4%	4.2%
Total Households:	**4,352**	**100.0%**	**3,820**	**100.0%**	
Median Household Income	**27,095**		**15,000**		
Per Capita Income	**12,444**				

Source: US Census, Universe = Households

Table 6.1.22 Age of Householder by Household Income

for Massachusetts, Worcester County, and Athol

AGE OF HOUSEHOLDER BY HOUSEHOLD INCOME IN 1989	Massachusetts	% of Households	Worcester Cty.	% of Households	Athol	% of Households
Under 25 years (total):	**102,426**	**5%**	**11,833**	**5%**	**233**	**5%**
Less than $5,000	9,843	0%	763	0%	16	0%
$5,000 to $9,999	14,531	1%	1,708	1%	37	1%
$10,000 to $14,999	10,371	0%	1,203	0%	26	1%
$15,000 to $24,999	21,269	1%	2,616	1%	80	2%
$25,000 to $34,999	17,384	1%	2,223	1%	41	1%
$35,000 to $49,999	17,007	1%	2,278	1%	21	0%
$50,000 to $74,999	8,982	0%	893	0%	7	0%
$75,000 to $99,999	2,006	0%	117	0%	5	0%
$100,000 or more	1,033	0%	32	0%	0	0%
25 to 34 years (total):	**481,127**	**21%**	**58,442**	**22%**	**950**	**22%**
Less than $5,000	16,095	1%	1,390	1%	26	1%
$5,000 to $9,999	26,581	1%	3,024	1%	75	2%
$10,000 to $14,999	20,028	1%	2,382	1%	93	2%
$15,000 to $24,999	62,111	3%	8,080	3%	183	4%
$25,000 to $34,999	82,458	4%	10,886	4%	197	5%
$35,000 to $49,999	115,495	5%	15,333	6%	234	5%
$50,000 to $74,999	109,833	5%	13,240	5%	125	3%
$75,000 to $99,999	30,971	1%	2,818	1%	6	0%
$100,000 or more	17,555	1%	1,289	0%	11	0%
35 to 44 years (total):	**493,400**	**22%**	**56,920**	**22%**	**791**	**18%**
Less than $5,000	11,626	1%	1,068	0%	34	1%
$5,000 to $9,999	17,240	1%	1,842	1%	59	1%
$10,000 to $14,999	16,168	1%	1,646	1%	22	1%
$15,000 to $24,999	48,755	2%	5,310	2%	106	2%
$25,000 to $34,999	68,547	3%	8,050	3%	127	3%
$35,000 to $49,999	111,196	5%	14,438	6%	255	6%
$50,000 to $74,999	128,751	6%	15,999	6%	137	3%
$75,000 to $99,999	50,545	2%	5,279	2%	46	1%
$100,000 or more	40,572	2%	3,288	1%	5	0%
45 to 54 years (total):	**344,374**	**15%**	**38,300**	**15%**	**592**	**14%**
Less than $5,000	7,765	0%	699	0%	22	1%
$5,000 to $9,999	11,443	1%	1,180	0%	20	0%
$10,000 to $14,999	10,459	0%	1,155	0%	44	1%
$15,000 to $24,999	29,640	1%	3,367	1%	93	2%
$25,000 to $34,999	37,770	2%	4,286	2%	59	1%
$35,000 to $49,999	63,707	3%	7,721	3%	170	4%
$50,000 to $74,999	89,230	4%	10,747	4%	122	3%
$75,000 to $99,999	48,454	2%	5,260	2%	29	1%
$100,000 or more	45,906	2%	3,885	1%	33	1%
55 to 64 years (total):	**302,929**	**13%**	**32,901**	**13%**	**597**	**14%**
Less than $5,000	10,717	0%	1,049	0%	0	0%
$5,000 to $9,999	18,693	1%	2,190	1%	32	1%
$10,000 to $14,999	15,406	1%	1,726	1%	85	2%
$15,000 to $24,999	37,445	2%	4,491	2%	122	3%
$25,000 to $34,999	39,722	2%	4,608	2%	113	3%
$35,000 to $49,999	55,539	2%	6,942	3%	83	2%
$50,000 to $74,999	62,897	3%	6,502	3%	119	3%
$75,000 to $99,999	31,869	1%	2,929	1%	14	0%
$100,000 or more	30,641	1%	2,464	1%	29	1%
65 to 74 years (total):	**295,291**	**13%**	**35,045**	**13%**	**595**	**14%**
Less than $5,000	15,287	1%	1,946	1%	41	1%
$5,000 to $9,999	48,510	2%	6,614	3%	90	2%
$10,000 to $14,999	37,044	2%	4,830	2%	86	2%
$15,000 to $24,999	61,248	3%	8,005	3%	146	3%
$25,000 to $34,999	43,355	2%	5,123	2%	85	2%
$35,000 to $49,999	38,482	2%	4,151	2%	92	2%
$50,000 to $74,999	30,308	1%	2,973	1%	36	1%
$75,000 to $99,999	11,104	0%	814	0%	8	0%
$100,000 or more	9,953	0%	589	0%	11	0%
75 years and over (total):	**224,859**	**10%**	**26,517**	**10%**	**594**	**14%**
Less than $5,000	19,962	1%	2,542	1%	44	1%
$5,000 to $9,999	72,408	3%	9,191	4%	220	5%
$10,000 to $14,999	36,882	2%	4,689	2%	102	2%
$15,000 to $24,999	39,336	2%	4,845	2%	122	3%
$25,000 to $34,999	21,497	1%	2,021	1%	50	1%
$35,000 to $49,999	15,624	1%	1,564	1%	33	1%
$50,000 to $74,999	11,644	1%	1,151	0%	23	1%
$75,000 to $99,999	3,857	0%	311	0%	0	0%
$100,000 or more	3,649	0%	203	0%	0	0%
Total Households:	**2,244,406**	**100%**	**259,958**	**100%**	**4,352**	**100%**

Source: US 1990 Census, Universe = Households

Table 6.1.23 1990 Poverty Status by Sex and by Age

for Massachusetts, Worcester County, and Athol

POVERTY STATUS IN 1989 BY SEX BY AGE	Massachusetts	% Person above/below poverty level	Worcester Cty.	% Person above/below poverty level	Athol	% Person above/below poverty level
Income in 1989 above poverty level (Total male and female):	**5,293,076**	**100.00%**	**626,729**	**100.00%**	**9,934**	**100.00%**
Male (Total):	**2,585,140**	**48.84%**	**310,069**	**49.47%**	**4,950**	**49.83%**
Under 5 years	177,810	3.36%	23,286	3.72%	423	4.26%
5 years	34,904	0.66%	4,825	0.77%	80	0.81%
6 to 11 years	193,445	3.65%	25,062	4.00%	502	5.05%
12 to 17 years	188,329	3.56%	24,111	3.85%	354	3.56%
18 to 64 years	1,708,106	32.27%	198,942	31.74%	3,000	30.20%
65 to 74 years	186,371	3.52%	22,132	3.53%	367	3.69%
75 years and over	96,175	1.82%	11,711	1.87%	224	2.25%
Female (Total):	**2,707,936**	**51.16%**	**316,660**	**50.53%**	**4,984**	**50.17%**
Under 5 years	168,993	3.19%	22,346	3.57%	341	3.43%
5 years	32,227	0.61%	4,050	0.65%	87	0.88%
6 to 11 years	183,443	3.47%	23,966	3.82%	334	3.36%
12 to 17 years	178,024	3.36%	22,761	3.63%	403	4.06%
18 to 64 years	1,732,873	32.74%	196,168	31.30%	2,824	28.43%
65 to 74 years	235,602	4.45%	27,543	4.39%	541	5.45%
75 years and over	176,774	3.34%	19,826	3.16%	454	4.57%
Income in 1989 below poverty level (Total male and female):	**519,339**	**100.00%**	**56,617**	**100.00%**	**1,312**	**100.00%**
Male (Total):	**209,230**	**40.29%**	**22,827**	**40.32%**	**526**	**40.09%**
Under 5 years	30,086	5.79%	3,593	6.35%	80	6.10%
5 years	5,736	1.10%	767	1.35%	34	2.59%
6 to 11 years	31,111	5.99%	3,518	6.21%	76	5.79%
12 to 17 years	21,872	4.21%	2,383	4.21%	86	6.55%
18 to 64 years	103,178	19.87%	10,440	18.44%	176	13.41%
65 to 74 years	9,067	1.75%	1,133	2.00%	24	1.83%
75 years and over	8,180	1.58%	993	1.75%	50	3.81%
Female (Total):	**310,109**	**59.71%**	**33,790**	**59.68%**	**786**	**59.91%**
Under 5 years	28,900	5.56%	3,093	5.46%	76	5.79%
5 years	5,913	1.14%	674	1.19%	5	0.38%
6 to 11 years	29,275	5.64%	3,484	6.15%	94	7.16%
12 to 17 years	23,328	4.49%	2,765	4.88%	94	7.16%
18 to 64 years	167,617	32.28%	16,888	29.83%	415	31.63%
65 to 74 years	24,072	4.64%	3,000	5.30%	54	4.12%
75 years and over	31,004	5.97%	3,886	6.86%	48	3.66%
Total persons for whom poverty status is determined:	**5,812,415**		**683,346**		**11,246**	

Source: US 1990 Census, Universe = Persons for whom poverty status is determined

Appendix BII

Occupations and Skill Categories

Appendix BII

Occupations and Skill Categories

Telecom Sales

Skill Categories	Knowledge and Skills Examples
Engineering/Scientific Core – those skills and subjects which are featured in an engineering or scientific college curriculum or training course	Baseband/broadband transmission, systems analysis, network requirements, data integrity/ security, usability, performance, quality standards, DSP, encryption
System Platform – knowledge of telecom systems and products	Wire vs. wireless, voice vs. data, or ...5ESS, SNA, OIS, Windows, routers, bridges, TCP/IP, client/server, UNIX, CDMA vs. TDMA, company specific products/services
Company Environment – knowledge of, and effectiveness with, the unique processes and tools for getting work done in my company	Customer service philosophies, company forms and databases, scheduling tools, "expert" knowledge-bases
Business/Industry – industry-specific knowledge that comes from working in an industry and meeting the needs of that industry and its customers; includes business strategies, business tactics, business processes, business organizations, & business planning	Industry-specific strategies: Government regulations, development cycles, learning curves, price sensitivities, names (of people, companies and products), costs, distribution channels, alliances, product life, product features, business analysis
Productivity Tools – the specific knowledge and skill with a group of tools and techniques that are necessary to complete telecommunications work	Spreadsheets, project management, databases, workgroup coordination, process management, marketing, risk management, contact managers
Personal/Interpersonal – skills for managing oneself and relationships with other people	Flexibility, customer relationship skills, negotiating, contacts/networking, presentation skills, teamwork, writing skills, leadership skills, persuasion, tracking, tact, prioritizing, political skills, expediting, questioning skills, forwarding motion (proactive), self-control, time management, listening skills, ability to handle stress

Customer Service

Skill Categories	Knowledge and Skills Examples
Engineering/Scientific Core – those skills and subjects which are featured in an engineering or scientific college curriculum or training course	Depends on specific product or service being supported
System Platform – knowledge of telecom systems and products	Wire vs. wireless, voice vs. data, TCP/IP, CDMA vs. TDMA, company specific products/services
Company Environment – knowledge of, and effectiveness with, the unique processes and tools for getting work done in my company	Customer service philosophies, company forms and databases, company rules for document control, text editor, scheduling tools, telephone, FAX, PC, "expert" knowledge-base, libraries, workgroup software
Business/Industry – industry-specific knowledge that comes from working in an industry and meeting the needs of that industry and its customers; includes business strategies, business tactics, business processes, business organizations, & business planning	Industry-specific strategies: Government regulations, development cycles, price sensitivities, names (of people, companies and products), costs, distribution channels, alliances, product life, product features, business analysis
Productivity Tools – the specific knowledge and skill with a group of tools and techniques that are necessary to complete telecommunications work	Spreadsheets, project management, databases, workgroup coordination, TQM, marketing, risk management
Personal/Interpersonal – skills for managing oneself and relationships with other people	Flexibility, customer relationship skills, negotiating, contacts/networking, problem solving, teamwork, persuasion, tracking, tact, prioritizing, political skills, expediting, questioning skills, forwarding motion (proactive), self-control, time management, listening skills, ability to handle stress

Installation Technicians

Skill Categories	Knowledge and Skills Examples
Engineering/Scientific Core – those skills and subjects which are featured in an engineering or scientific college curriculum or training course	Baseband/broadband transmission, RF systems, testing, reliability, safety, data integrity/security, maintenance, usability, quality, optical fundamentals, fiber cabling
System Platform – knowledge of telecom systems and products	Wire vs. wireless, voice vs. data, or ...5ESS, SNA, routers, bridges, TCP/IP, client/server, UNIX, CDMA vs. TDMA, company specific products/services, telecom technical standards (eg. CAT-5)
Company Environment – knowledge of, and effectiveness with, the unique processes and tools for getting work done in my company	Customer service philosophies, company forms and databases, scheduling tools, telephone, FAX, PC, "expert" knowledge-base
Business/Industry – industry-specific knowledge that comes from working in an industry and meeting the needs of that industry and its customers; includes business strategies, business tactics, business processes, business organizations, & business planning	Industry-specific strategies: Government regulations, building wiring codes
Productivity Tools – the specific knowledge and skill with a group of tools and techniques that are necessary to complete telecommunications work	Workgroup coordination, TQM, process management
Personal/Interpersonal – skills for managing oneself and relationships with other people	Flexibility, customer relationship skills, negotiating, teamwork, problem solving, persuasion, tracking, tact, prioritizing, expediting, questioning skills, forwarding motion (proactive), self-control, time management, listening skills, ability to handle stress

Application Engineers

Skill Categories	Knowledge and Skills Examples
Engineering/Scientific Core – those skills and subjects which are featured in an engineering or scientific college curriculum or training course	Baseband/broadband transmission, systems analysis, network requirements, reliability, safety, data integrity/security, maintenance, usability, performance, interoperability, quality, systems engineering, process engineering, standards, data types, encryption
System Platform – knowledge of telecom systems and products	Wire vs. wireless, voice vs. data, or ...5ESS, SNA, routers, bridges, TCP/IP, client/server, UNIX, CDMA vs. TDMA, company specific products/services, C/C++
Company Environment – knowledge of, and effectiveness with, the unique processes and tools for getting work done in my company	Customer service philosophies, company forms and databases, company rules for document control, version control, text editor, scheduling tools, telephone, FAX, PC, "expert" knowledge-base, libraries, workgroup software
Business/Industry – industry-specific knowledge that comes from working in an industry and meeting the needs of that industry and its customers; includes business strategies, business tactics, business processes, business organizations, & business planning	Industry-specific strategies and customer processes: Government regulations, development cycles, learning curves, price sensitivities, names (of people, companies and products), costs, distribution channels, alliances, product life, product features, business analysis
Productivity Tools – the specific knowledge and skill with a group of tools and techniques that are necessary to complete telecommunications work	Spreadsheets, project management, databases, workgroup coordination, TQM, process management, text editing, risk management,
Personal/Interpersonal – skills for managing oneself and relationships with other people	Flexibility, customer relationship skills, negotiating, contacts/networking, problem soving, presentation skills, teamwork, writing skills, leadership skills, persuasion, tracking, tact, prioritizing, political skills, expediting, questioning skills, forwarding motion (proactive), self-control, time management, listening skills, ability to handle stress

Telecom Engineers

Skill Categories	Knowledge and Skills Examples
Engineering/Scientific Core – those skills and subjects which are featured in an engineering or scientific college curriculum or training course	Baseband/broadband transmission, RF systems, real-time embedded systems, systems analysis, network requirements, design, testing, reliability, safety, data integrity/security, maintenance, usability, performance, interoperability, quality, systems engineering, process engineering, standards, control theory, Boolean algebra, DSP, cad/cam, physics, data types, encryption, lasers
System Platform – knowledge of telecom systems and products	Wire vs. wireless, voice vs. data, or ...5ESS, SNA, OIS, Windows, PCMCIA, routers, bridges, TCP/IP, client/server, UNIX, C/C++, CDMA vs. TDMA, Lotus Notes, company specific products/services, NT, telecom technical standards
Company Environment – knowledge of, and effectiveness with, the unique processes and tools for getting work done in my company	Customer service philosophies, company forms and databases, company rules for document control, version control, text editor, scheduling tools, telephone, FAX, PC, "expert" knowledge-base, libraries, workgroup software
Business/Industry – industry-specific knowledge that comes from working in an industry and meeting the needs of that industry and its customers; includes business strategies, business tactics, business processes, business organizations, & business planning	Industry-specific strategies: Government regulations, development cycles, learning curves, price sensitivities, names (of people, companies and products), costs, product life, product features
Productivity Tools – the specific knowledge and skill with a group of tools and techniques that are necessary to complete telecommunications work	Spreadsheets, project management, databases, workgroup coordination, TQM, process management, text editing, manufacturing methods, marketing, risk management
Personal/Interpersonal – skills for managing oneself and relationships with other people	Flexibility, customer relationship skills, negotiating, contacts/networking, presentation skills, teamwork, writing skills, problem solving, persuasion, tracking, tact, prioritizing, political skills, expediting, questioning skills, forwarding motion (proactive), self-control, time management, listening skills, ability to handle stress

Appendix CII

Topographic Map of Athol

Appendix DII

Federal Lands in Athol

Appendix DII

Federal Lands in Athol

(Source: Athol Assessors Office, 1997)

Map	Lot	Block	Location	Bldg No	LIN #	Use Code	Zone	Infl Fact	S I	Cndtn Fact	Notes	Unit Price	Units	Unit Type
1	1		ROYALSTON RD	1	1	9000	RC	1.00	5	.10		0.40	43,560.00	SF
1	1		ROYALSTON RD	1	2	9000	RC	1.00	0	.50		700.00	17.70	AC
1	2		W ROYALSTON RD	1	1	9000	RC	1.00	5	1.00		0.40	43,560.00	SF
1	2		W ROYALSTON RD	1	2	9000	RC	1.00	5	1.00		700.00	2.80	AC
1	3		W ROYALSTON RD	1	1	9000	RC	1.00	5	1.00		0.40	43,560.00	SF
1	3		W ROYALSTON RD	1	2	9000	RC	1.00	5	1.00		700.00	3.30	AC
1	3		W ROYALSTON RD	1	3	9000	RC	1.00	5	.50		20.00	1,120.00	FF
1	4		W ROYALSTON RD	1	1	9000	RC	1.00	5	1.00		0.40	43,560.00	SF
1	4		W ROYALSTON RD	1	2	9000	RC	1.00	5	1.00		700.00	4.00	AC
1	10		CHESTNUT HILL AV	1	1	9000	RC	1.00	5	.10		0.40	43,560.00	SF
1	10		CHESTNUT HILL AV	1	2	9000	RC	1.00	5	.10	LL	700.00	8.70	AC
1	11		W ROYALSTON RD	1	1	9000	RC	1.00	5	.10		0.40	43,560.00	SF
1	11		W ROYALSTON RD	1	2	9000	RC	1.00	5	.10	LL	700.00	13.50	AC
1	12		CHESTNUT HILL AV	1	1	9000	RC	1.00	5	.10		0.40	43,560.00	SF
1	12		CHESTNUT HILL AV	1	2	9000	RC	1.00	5	.10	LL	700.00	21.20	AC
1	46		OLD KEENE RD	1	1	9000	RC	1.10	6	.10		0.40	43,560.00	SF
1	46		OLD KEENE RD	1	2	9000	RC	1.10	6	.50		700.00	3.80	AC
30	72		242 MAIN ST	1	1	9000	RB	1.00	5	3.50		0.57	25,470.00	SF

Appendix EII

List of References

Appendix EII

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